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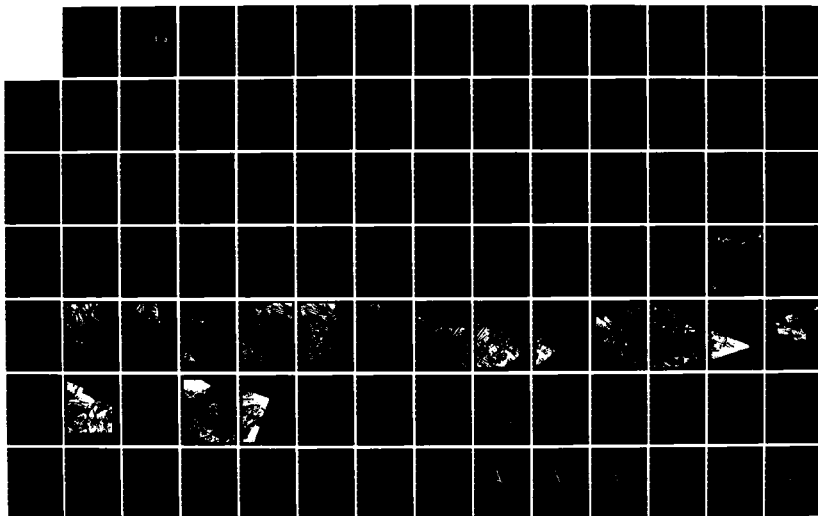
CUYAHOGA RIVER OHIO RESTORATION STUDY: MAIN REPORT
FLOOD CONTROL IN THE VALLEY VIEW/INDEPENDENCE AREA(U)
CORPS OF ENGINEERS BUFFALO NY BUFFALO DISTRICT DEC 85

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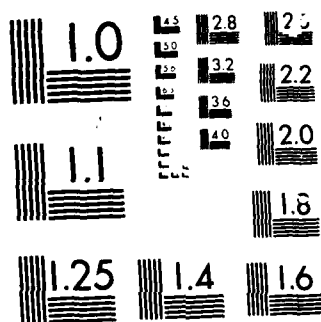
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Draft Final Feasibility Report
on Flood Control
in the Valley View/Independence Area



AD-A166 017

Cuyahoga River, Ohio Restoration Study

Main Report

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US Army Corps
of Engineers
Buffalo District

December 1985

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CUYAHOGA RIVER, OHIO
RESTORATION STUDY
DRAFT FINAL FEASIBILITY REPORT
ON
FLOOD CONTROL

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ACKNOWLEDGEMENTS

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Richard Aguglia	Project Manager, Plan Formulation Branch
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Salvatore Nobile	Civil Engineering Technician
Robert Dragonette	Real Estate Specialist
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John Acker	Drafting Section
Paul Ehrensberger	Drafting Section
Mary Ann Schultz	Word Processor
Linda Saubaran	Word Processor

The Buffalo District Commander during preparation of this Draft Final Feasibility Report was Colonel Daniel R. Clark; the Chief of the Engineering Division was Kenneth R. Hallock; and the Chief of the Planning Division was John Zorich.

Finally, the efforts of other individuals who participated in the study and report preparation but whose names have not been mentioned above, are gratefully acknowledged.

SECTION I INTRODUCTION

The purpose of this section is to introduce the reader to the Cuyahoga River Restoration Study - Final Report on Flood Control in the Valley View/Independence area and to explain the content and organization of this report. The section presents information on the geographical setting of the study area, the study authority, the purpose of the study, the scope of the study, study participants and coordination, the organization of the report, and prior studies and reports in the area.

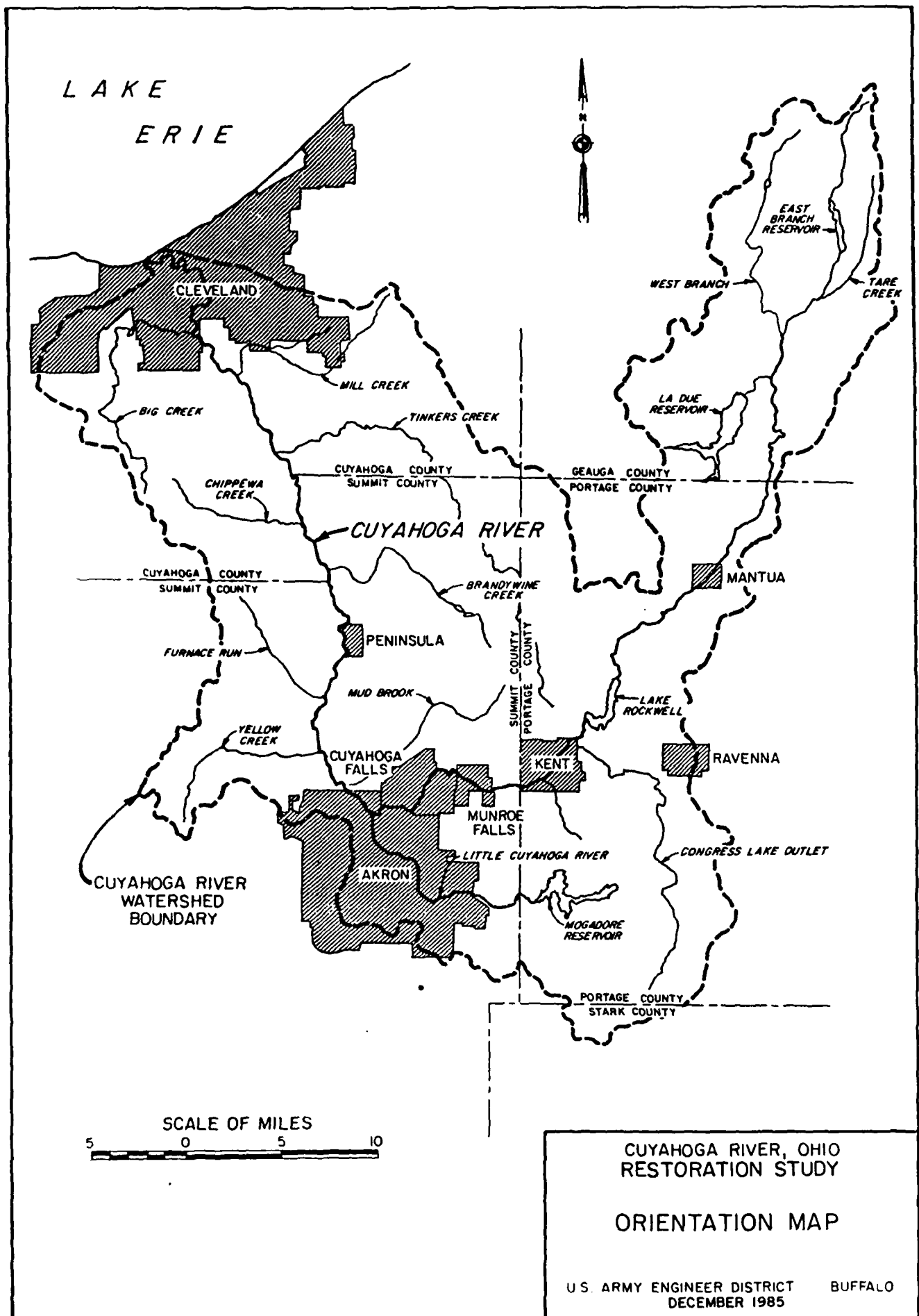
1. GEOGRAPHICAL SETTING

The Cuyahoga River is about 100 miles long and drains some 810 square miles of northeastern Ohio as shown on Figure 1. The river begins at an elevation of about 1,300 feet, several miles northeast of Burton in Geauga County, and flows in a southerly direction towards Hiram Rapids, where the direction changes southwesterly through Mantua, Kent, and Cuyahoga Falls, to the confluence with the Little Cuyahoga River at Akron. From Akron, the river flows north to Cleveland, to an elevation of about 570 feet. The lower 5.8 miles are part of an existing Federal navigation project for Cleveland Harbor, one of Lake Erie's major ports.

The main tributaries of the Cuyahoga River are: Big, Mill, Brandywine, Tinkers, Yellow, and Chippawa Creeks; Mud Brook, Furnace Run, Little Cuyahoga River, Congress Lake Outlet (Breakneck Creek), and West Branch Cuyahoga River. The overall basin consists of rolling hills and many natural small lakes and ponds. A relatively distinct escarpment near Cleveland divides the basin between an upland plateau and the narrow lake plain.

2. STUDY AUTHORITY

The Cuyahoga River Restoration Study was initiated by the Flood Control Act of 1968 (Section 219) which authorized a survey of the "Cuyahoga River from Upper Kent to Portage Trail in Cuyahoga Falls, OH, in the interest of flood control, pollution abatement, low-flow regulation, and other allied water purposes." No studies were completed under the 1968 authorization because of adverse public reaction to the limited study scope as presented at the initial public meeting on 16 September 1970. At this meeting, local interests stated their desire for environmental and aesthetic improvement programs to complement existing and proposed flood control studies. This led to expansion of the scope of the study under the authority of Section 108 of the 1970 River and Harbor Act, that instructed the Secretary of the Army, acting through the Chief of Engineers to "investigate, study, and undertake measures in the interest of water quality, environmental quality, recreation, fish and wildlife, and flood control, for the Cuyahoga River Basin, OH. Such measures shall include, but not be limited to, clearing, snagging, and removal of debris from the river's bed and banks; dredging and structural works to improve streamflow and water quality; and bank stabilization by vegetation and other means."



The authorization was sponsored by the Cuyahoga River Reclamation Commission, an agency of the city of Cuyahoga Falls. Congressional support came from former Senator Stephen M. Young and former Congressmen J. William Stanton (11th District) and William H. Ayres (14th District). The 1970 authorization was sponsored by Congressman Louis B. Stokes (21st District) and former Congressman Charles A. Mosher (13th District).

The following is the text of the Authorization:

a. Flood Control Act of 1968

"Section 219. The Secretary of the Army is hereby authorized and directed to cause surveys for flood control and allied purposes including channel and major drainage improvements . . . to be made under the direction of the Chief of Engineers, in drainage areas of the United States and its territorial possessions, which include the localities specifically named in this section. After the regular or formal reports made on any survey authorized by this section are submitted to Congress, no supplemental or additional report or estimate shall be made unless authorized by law except that the Secretary of the Army may cause a review of any examination or survey to be made and a report thereon submitted to Congress, if such review is required by national defense or by changed physical or economic conditions . . . Cuyahoga River from Upper Kent to Portage Trail in Cuyahoga Falls, Ohio, in the interest of flood control, pollution abatement, low flow regulation, and other allied water purposes. . ." (underline added)

b. River and Harbor Act of 1970

"Section 108. (a) The Secretary of the Army, acting through the Chief of Engineers, is authorized to investigate, study, and undertake measures in the interests of water quality, environmental quality, recreation, fish and wildlife, and flood control, for the Cuyahoga River Basin, Ohio. Such measures shall include, but not be limited to, clearing, snagging, and removal of debris from the river's bed and banks; dredging and structural works to improve stream flow and water quality; and bank stabilization by vegetation and other means. In carrying out such studies and investigations the Secretary of the Army, acting through the Chief of Engineers, shall cooperate with interested Federal and State agencies." (underline added)
(b) Prior to initiation of measures authorized by this section, such non-Federal public interests as the Secretary of the Army, acting through the Chief of Engineers, may require, shall agree to such conditions of cooperation as the Secretary of the Army, acting through the Chief of Engineers, determines appropriate, except that such conditions shall be similar to those required for similar project purposes in other Federal water resources projects." (underline added)

3. PURPOSE OF FINAL REPORT

Flooding in the Cuyahoga River Basin is a frequent and costly problem for local residents. For example, the most recent major flood, which occurred in

September 1979 and which had a frequency of occurrence of about once in 40 years, caused in excess of \$3 million in damages. Local interests have repeatedly requested assistance in alleviating these flood damages.

In response to these requests and in accordance with the authorizing resolutions, the Buffalo District investigated the feasibility of providing flood protection for the Cuyahoga River Basin in the Second Interim Feasibility Report for the Cuyahoga River Resotation Study (CRRS). Five floodprone areas were identified in the study and corrective plans for these areas were developed. The five areas investigated were: Lower Cuyahoga (from river mile 5.8 to river mile 18.8), village of Mantua, Hudson Village, city of Streetsboro, and Twinsburg. Types of improvements considered were: channelization; reservoirs; and floodproofing. However, no plan was economically justified and the Second Interim Flood Control Study was terminated in 1976. (Note: As will be discussed in subsequent sections of this report, flooding along Big Creek was investigated in the First Interim Report and a flood control plan was recommended for implementation as an early action item.)

Subesquent to completion of the Second Interim Report, local interests in the Valley View/Independence area (between river mile 11 and river mile 16 - see Figure 2) requested that smaller-scale flood control measures, such as minor channelization, clearing and snagging, debris removal, and/or ring levees be investigated for areas within their communities where high flood damages occur. In addition, several flood events occurred subsequent to completion of the Second Interim Report which indicated that the damage-frequency curves for the Valley View/Independence area used in the previous study may have been too low, thus underestimating potential flood control benefits. Based on the above, it was deemed appropriate to reevaluate the flooding problem in the Valley View/Independence area with a view towards providing some limited degree of protection for concentrated damage areas in the Final Report for the CRRS.

4. SCOPE OF STUDY

The scope of this feasibility study on flood control is limited to formulation, assessment, and evaluation of plans to reduce flood damages in the Valley View/Independence area. As will be discussed in Section III of the Main Report, "Problem Identification," the study scope was further reduced during the early phase of the study to four specific locations within the Valley View/Independence area where concentrated development exists and which experiences persistent and frequent flooding. Since the Second Interim Study indicated that no flood control plan to protect the entire reach of the river was economically justified, no further consideration was given to such a regional plan during the course of this feasibility study.

5. STUDY PARTICIPANTS AND COORDINATION

The decision to reevaluate the feasibility of providing some limited degree of flood protection in the Valley View/Independence area was predicated on responses to the Buffalo District Engineer's 3 January 1977 Public Notice requesting public views on the future direction of the remainder of the

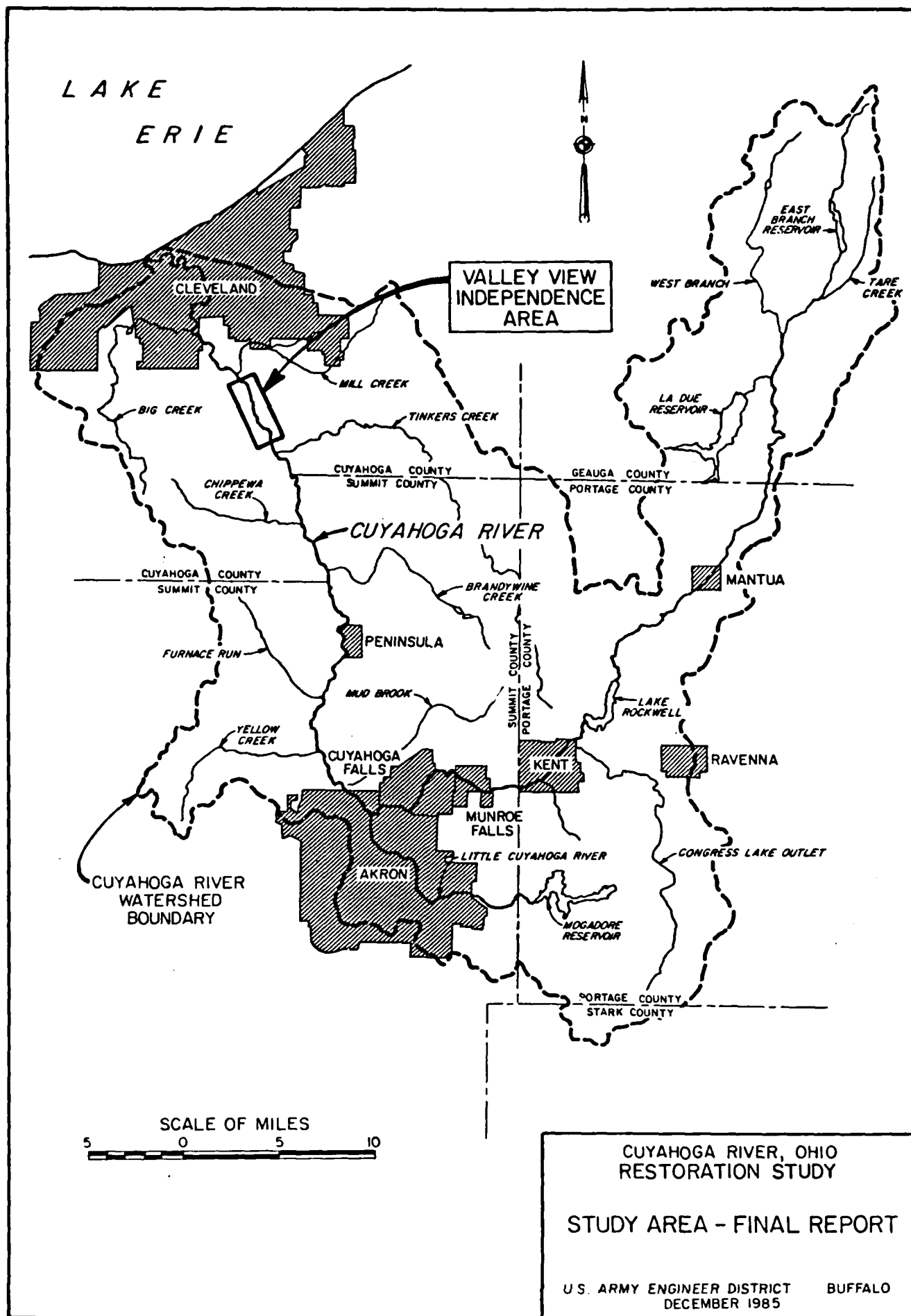


FIGURE 2

Cuyahoga River Restoration Study. Responses received indicated strong support for this reanalysis from both private citizens and governmental agencies. A copy of the Public Notice and the responses received are presented in Appendix C of the "Revised Plan of Study, Cuyahoga River Restoration Study" (January 1978). Local interests continue to support the study, as indicated by recent expressions of local interest from the Cuyahoga County Commissioners who have also indicated their intent to act as the project's local sponsor.

During the preliminary planning phase of this feasibility study coordination was initiated with various Federal, State, and local agencies in order to identify significant impacts of proposed flood control plans as early as possible. Specifically, information was requested regarding existing or proposed land use plans, known cultural resources, and fish and wildlife resources, including threatened and endangered species. Five responses were received as a result of this early request. The Northeast Ohio Areawide Coordinating Agency (NOACA) stated that reduction of flooding in the Valley View/Independence area would improve water quality since sediment and other pollutants are washed into the river when flooding occurs. The Ohio Department of Natural Resources (ODNR) replied that they were not aware of any rare or endangered species within the study area. The U.S. Fish and Wildlife Service provided additional information on threatened or endangered species that may be present in the study area. The State Historic Preservation Officer (SHPO) provided information on known cultural resources in the area and recommended that further evaluation of cultural resources be undertaken as the study progressed. The SHPO reiterated this request during the detailed planning phase and a cultural reconnaissance study was conducted. The National Park Service, who is responsible for management of the Cuyahoga Valley National Recreation Area (CVNRA) partially located within the study area, outlined their natural resource policies pertaining to flooding within the recreation area. In addition, the Park Service provided input in development of several flood control plans for areas located within the recreation area throughout the entire study process.

The completed Preliminary Feasibility Report for this study, documenting the results of the preliminary planning effort, was distributed to the political leaders in the area and to various local, State, and Federal agencies for their review and comment. Loan copies of the report were also supplied to local libraries for review by the general public and various civic groups. In addition, until the supply was exhausted, personal copies of the report were made available to study participants free of charge. With the exception of requests for additional copies, no comments were received on the report.

Following approval of this Draft Final Feasibility Report, a public meeting will be held in the study area. The purposes of this meeting will be to present the results of the feasibility study, including the Tentatively Recommended Plan, and to solicit public comment. All comments made at this meeting will be given equal consideration in developing the final recommendation of this study.

6. THE REPORT

The overall organization of this report consists of a Main Report and supporting documentation. The Main Report is written to give both the general and technical reader a clear understanding of the study, the study results, and the key decisions and conclusions. The supporting documentation provides additional detailed information on the design, costs, and benefits of the alternatives studied. It also includes copies of pertinent correspondence with organizations and individuals significant in the development of this study and minutes of the workshop meetings conducted during the course of this study. Copies of the supporting documentation are available at the Buffalo District Office.

7. PRIOR STUDIES AND REPORTS

Many studies of the water resources problems and needs in the Cuyahoga River Watershed have been made. The following is a summary of the various reports pertinent to the flooding problem in the Valley View/Independence area which is the concern of this feasibility study:

a. Beginning in 1914, there have been 15 Corps of Engineers reports that address improvements to and modification of the Cleveland Harbor commercial navigation project at Lake Erie and the mouth of the Cuyahoga River. The most recent of these reports is the "Cleveland Harbor, OH, Final Reformulation Phase I General Design Memorandum" (July 1984, Revised December 1984). This report recommended modifications to the lakefront portion of the harbor in the interest of moving bulk and general cargo more efficiently and economically through the harbor. The report is currently at the office of the Assistant Secretary of the Army for Civil Works awaiting transmittal to the Office of Management and Budget. The project was also included in the 1985 Supplemental Appropriations Act (PL 99-88) and will be authorized for construction if an Omnibus Water Resources Bill is not passed by 15 May 1986.

b. The "Review of Reports on Cleveland Harbor" (February 1945) investigated, among other things, the feasibility of constructing a settling basin for sediment above the head of navigation either by means of a channel extension or a permanent reservoir in the valley south of Cleveland. The report concluded that this work was not economically justified at that time.

c. In response to U.S. House of Representative's Committee resolutions of 28 December 1946 and 9 June 1960, the Buffalo District prepared a report entitled "Review of Reports for Flood Control and Allied Purposes, Cuyahoga River, OH" (1 September 1969) recommending:

(1) Improvements for flood control and streambank erosion in the 9-mile reach of the Cuyahoga River between the Harvard-Dension Bridge (approximate river mile 7) and the mouth of Tinkers Creek (approximate river mile 16).

(2) Construction of a sediment settling basin in the vicinity of river mile 8.0 (approximately 2 miles upstream from the head of commercial navigation) in the interest of commercial navigation, pollution abatement, and Lake Erie restoration.

The report was returned to the Buffalo District in June 1970 as the necessary local assurances were not furnished to cover the cost-sharing requirements for a cash contribution in return for windfall benefits. For this reason, and because subsequent legislation for the Cuyahoga River Restoration Study under Section 108 of the 1970 River and Harbor Act provided for expanded study scope, no further action was taken on the 1969 Review of Reports.

d. In August 1973, the Buffalo District completed the "Wastewater Management Study for Cleveland-Akron Metropolitan and Three Rivers Watershed Area" which evaluated alternative plans for water quality improvement in the Cuyahoga, Chagrin, and Rocky River watersheds and receiving Lake Erie by treatment of municipal and industrial wastewaters and urban storm runoff. The findings of this study, which identified four alternative land and water-oriented methods for wastewater treatment, along with the findings of similar studies conducted by the Corps of Engineers in five other areas, were submitted to both houses of Congress by the Secretary of the Army (SOA) by letter dated 28 April 1978. No recommendation for program implementation was provided by the SOA.

e. Section 108d of Public Law 92-500 directed the Corps of Engineers to develop a program for the "restoration and environmental repair" of Lake Erie. The resulting Lake Erie Wastewater Management Study (LEWWM), completed in 1982 by the Buffalo District, identified nutrient enrichment - particularly phosphorus in all of its forms - as the primary cause of heavy eutrophication in the western basin of Lake Erie and marginal eutrophication in the central and eastern basins. The study also determined that 44 percent of the phosphorus loading to Lake Erie is from nonpoint or diffuse sources such as that attached to sediment. The Final Report, outlining a 10-year conservation tillage program as the most cost effective method of reducing phosphorus pollution in Lake Erie, was sent forward to Congress "for its information."

f. As previously discussed in Paragraph 2, the authority for the Cuyahoga River Restoration Study (CRRS), under which this Final Report on Flood Control in the Valley View/Independence area is being conducted, was provided by Section 108 of the 1970 River and Harbor Act. A synopsis of accomplishments under this authority follows:

(1) The First Interim Report (September 1971) presented the scope of the longer-term Framework Plan plus an Early-Action Program for the Cuyahoga River Restoration Study. The Framework Plan presented a description of the basin's resource problems and needs, and possible alternative means of dealing with these problems and needs. Sources of pollution and other degradable conditions were sought out and identified. Current pollution abatement programs were inventoried to determine their effects on pollution. The Early-Action Program consisted of four action programs that were considered compatible with the overall framework plan and which could be constructed or accomplished without additional study. The four early-action programs were:

(a) Recreational improvements such as canoe docks and landscaping at Waterworks Park-Cuyahoga Falls (river mile 49.0) and Fuller Park-Kent (river mile 54.0). In a letter to Congress dated 25 September 1975, the Secretary of the Army deferred these proposed recreational facilities. The Secretary

also indicated that these facilities would be reviewed in subsequent studies of the basin. As stated in the "Revised Plan of Study, Cuyahoga River Restoration Study" (January 1978), it was the consensus of the local officials that present and future recreational needs have been identified and programs for expansion to meet these needs have been outlined. Therefore, the need for improving the recreational facilities in the basin under the Cuyahoga River Restoration Study will not be investigated further.

(b) Debris removal from Cleveland Harbor. The Secretary of the Army also deferred implementation of this program because he concluded that "... removal of debris outside the Federal channel should be prosecuted by non-Federal interests."

(c) Flood control and aesthetic improvements on Big Creek at the Cleveland Zoological Park. Funds to begin advanced engineering and design for this \$25 million project were released in October 1975. The Phase II General Design Memorandum was completed in FY 79. Plans and Specifications were essentially completed in FY 80. However, construction has not been initiated due to lack of Federal funding which has been withheld because the project is not economically viable at the ever increasing Federal discount rate. Historically, a project would have proceeded based upon the discount rate that prevailed at the time construction funds were first appropriated. This reasoning has not held up for this project.

(d) Pilot sediment removal project on the upstream side of the dam at Brecksville, OH. On 16 July 1976, the Buffalo District Engineer recommended that the Pilot Sediment Removal Project be terminated. The project showed that sediment removal was not a feasible means of improving water quality on the upstream side of the Brecksville, OH, dam because the sediment in this area was relatively unpolluted, with no oxygen depletion. This recommendation was concurred with by the Division Engineer and approved by the Office of the Chief of Engineers by letter dated 9 December 1976.

(2) One of the actions under the Cuyahoga River Restoration Study was an investigation of the existing water quality conditions in the river basin entitled "Ecological Monitoring of the Cuyahoga River" (October 1974) by Dr. John Olive of the University of Akron through a contract with the Buffalo District. The purpose of this investigation was to establish the baseline biological, chemical, and physical characteristics of the central Cuyahoga River environment; to evaluate the river's existing and unaltered projected environmental trends; and to extrapolate what the anticipated environmental changes would be as a result of implementing the Pilot Sediment Removal Program. This investigation included physiographic, chemical, physical, and biological data collection from seven sites along the Cuyahoga River, one of which was at the upstream side of the Brecksville Dam. The sampling period for this data collection program was from October 1973 to September 1974. The results of this study indicated that: (1) sediment upstream of the Brecksville dam was nonpolluted to moderately polluted when compared to EPA sediment standards; (2) sediments which are deposited on the upstream side of the Brecksville Dam in August and September are scoured during the high flow regimes of February and March; and (3) the water at the Brecksville site was always well oxygenated and the dissolved oxygen level never fell below 5 ppm.

The results of this study were utilized in terminating the Pilot Sediment Removal Project (an early-action program).

(3) The Second Interim Report (March 1976) identified the significant flooding problems within the Cuyahoga River Basin and developed corrective plans for these problems. The flood problem areas studied in the "Second Interim Report" were: Lower Cuyahoga, village of Mantua, Hudson Village, city of Streetsboro, and Twinsburg. In the report, it was concluded that flood control plans were not economically justified for the flooding problems in the Cuyahoga River Basin (excluding the Big Creek improvements). Further, it was recommended that, in general, the affected communities implement flood plain management programs to prevent increased flood damages. The Corps can assist the communities in developing their programs under the Technical Assistance portion of the Flood Plain Management Program.

(4) The Third Interim Report on Erosion and Sedimentation was initiated in FY 77 and the Preliminary Feasibility Report was essentially completed in FY 80. The major portion of the preliminary feasibility investigation was conducted by the Soil Conservation Service of USDA under an Interagency Agreement. The results of the preliminary feasibility studies were that upland (sheet and rill) erosion contribute significantly (approximately 50 percent) to the Cuyahoga River sediment load (including Cleveland Harbor) while streambank erosion is a minor contributor (approximately 5 percent). The study also indicated that streambank erosion control plans were not economically justified and recommended that no further consideration be given to streambank erosion control plans at this time. The preliminary feasibility studies also reevaluated the settling basin early-action project and determined that, due to recent development in the area, the original disposal sites were no longer available and no alternate disposal site was available in the immediate vicinity. In addition, coordination with local interests indicated that local interests were still opposed to the settling basin project. Thus, the recommendation of the study was that no further consideration be given to the settling basin early-action project. The Soil Conservation Service collected field data to complete the remaining upland erosion studies in the summer of FY 80. This information was incorporated into a Public Information Report which was provided to local interests in December 1982.

g. In November 1977, the Buffalo District completed a Section 14 report entitled "Erosion of Cuyahoga Riverbank Along Stone Road in Valley View, OH." The purposes of this report were to develop a plan for the protection of about 300 feet of Stone Road in Valley View, OH, against further damage and possible total destruction from the continuing erosion of the adjacent bank of the Cuyahoga River and to evaluate the economic feasibility of the protection project. The investigation indicated that the erosion problem on the Cuyahoga River along Stone Road was critical and the loss of Stone Road would have a significant adverse impact on the physical and social well-being of the local residents. The investigation also indicated that the most economical solution to the problem was to relocate approximately 600 feet of Stone Road away from the river. Since relocation costs are the responsibility of local interests no further Federal action was warranted.

SECTION II EXISTING CONDITIONS

The purpose of this section is to present the environmental setting without the project to permit impact assessment of the various alternatives. The information presented will provide a data base for impact assessment and evaluation purposes.

8. PHYSICAL ENVIRONMENT

a. Location.

The study area consists of the Valley View/Independence area along the Cuyahoga River from approximately river mile 11.0 to river mile 16.0 - see Figure 2. As will be discussed in the following section of this report, the study area was further reduced during the early phase of the study to four specific sites within this area. Two sites are commercial/industrial areas abutting the west bank of the Cuyahoga River in the city of Independence, Cuyahoga County, OH (Sites 1 and 3); and two sites are residential areas bordering the east bank of the Ohio Canal in the village of Valley View, Cuyahoga County, OH (Sites 2 and 4). Plate 7 shows the location of the four specific project sites.

b. Physiography/Topography.

The project area is situated on the western edge of the Appalachian Plateau. Gently to moderately sloped and rolling uplands are formed of glacial ground and end moraines. The soil materials of clay, silt, sand, and gravel till were laid down over bedrock shales and sandstone.

c. Geology.

Rock strata of the Devonian, Mississippian and Pennsylvanian sedimentary systems are exposed throughout the Cuyahoga River Basin. These deposits are economically important and support a shale and sandstone industry. Older Silurian, Ordovician, and Cambrian systems are frequently encountered when drilling for wells or other shafts.

Surface exposures of Devonian Chagrin and Ohio shales, Mississippian Bedford formation, Berea sandstone, and Cuyahoga Group shales and sandstones are best exposed in the lower valley and the gorges of adjoining tributaries. The Berea sandstone is the more resistant of these rocks to the forces of erosion that have shaped the valley. In general, this rock forms the abrupt edge of the Portage Escarpment to the east of the valley. It is also present to the west but the relief is less abrupt.

Pennsylvanian age rocks of the Pottsville Formation are found to the south and east in the study area lying unconformably on the Mississippian. The complete series of Pottsville is a sequence of coals, shales, limestones, and sandstones. Sharon conglomerate, a sandstone, is the lower and more widespread Pennsylvanian layer in the area (Cleveland Regional Sewer District, 1976).

d. Soils.

Soils at Project Sites 2, 3, and 4 belong to the Chagrin-Tioga-Euclid association. These are nearly level, well-drained, and somewhat poorly drained soils that formed in loamy and sandy alluvium and in silty and loamy deposits. They occupy flood plains and low stream terraces. Project Site 1 occupies urban land, described as nearly level and gently sloping areas that are predominately covered by buildings, structures, concrete, asphalt, and other impervious surfaces. (USDA, Soil Conservation Service, 1980).

The following soils which are present within the project sites have been designated as prime farmlands (USDA, Soil Conservation Service, 1981):

- Chagrin silt loam, occasionally flooded (Sites 1, 2, 3, 4)
- Euclid silt loam (Sites 2, 4)
- Sebring silt loam (Site 4)

Despite this designation, commercial/industrial and residential development preclude extensive use of these soils for agriculture throughout much of the project sites.

e. Climate.

The climate of the Cuyahoga River Basin is mainly humid, continental in character, with an annual average precipitation of 30.6 to 44.2 inches. The basin experiences strong, modifying influences from Lake Erie. Northwestern winds crossing Lake Erie tend to lower temperatures in the summer and raise them in the winter with an annual average of 49.8°F. Winds blowing across the lake in winter often bring heavy snow squalls, sometimes as late as May. Average annual snowfall varies from 46.7 to 109.3 inches per year.

Prevailing winds are from the southwest throughout the year with the average velocity being approximately 10 miles per hour. Damaging winds of 35 to 85 miles per hour associated with thunderstorms occasionally occur in spring and summer.

f. Water Quality.

All surface waters in Ohio are designated for Warmwater Habitat, Agricultural Water Supply, Industrial Water Supply, and Primary Contact Recreation. However, in lieu of Primary Contact Recreation, the Cuyahoga River segment from its confluence with the Little Cuyahoga River near Akron to the Cleveland Southerly Sewage Treatment Plant (STP) (river mile 11.0) has been designated for Secondary Contact Recreation. The four proposed project sites border this river segment. In addition, the river segment from Bath Road in Northampton to Rockside Road in Valley View (Cuyahoga Valley National Recreation Area) has been designated State and National Resource Waters (Project Site 4 borders this river segment).

The Ohio Environmental Protection Agency (OEPA) requires that ambient water quality be maintained for all substances determined to be toxic or to interfere with any of the river's designated uses. All other substances must be

limited to the standards associated with each designated use. Areas that do not meet general water quality standards must not be degraded for such classified waters (OEPA Water Quality Standards Chapter 3745*) of the Administrative Code). Table 1 shows that mean levels of fecal coliform bacteria, copper, iron, and cyanide exceed state water quality standards.

As of 1974, water quality in the Cuyahoga River between Bath Road and Rockside Road appears to be improving. Upstream sections of the river and its tributaries currently support healthy benthic populations and diverse breeding populations of fish that could be available to repopulate the mainstem of the river in the study area if water quality were enhanced significantly. Data has indicated that dissolved solids and chloride concentrations are decreasing, and dissolved oxygen concentrations are increasing. Visual observations have indicated that foam caused by detergents has become less of a problem than formerly. Improved treatment of wastewater by Akron industries and by the Botzum wastewater treatment plant probably has been responsible for this improvement (Jack McCormick and Associates, 1974).

Table 1 - Cuyahoga River Water Quality, 1978-83

Parameter	Mean	Maximum	Minimum	OEPA Standard
DO (mg/l)	8.7	13.4	6.5	>4.0
pH	7.6	8.2	6.6	6.5-9.0
Fecal Coliforms/100ml	19,272.8*	66,000.0*	460.0	5,000.0
Calcium (mg/l)	57.1	81.0	0.1	----
Magnesium (mg/l)	15.0	19.7	11.5	----
Cadmium (ug/l)	4.3	20.0*	0.5	12.0
Chromium (ug/l)	30.7	50.0	30.0	50.0
Copper (ug/l)	31.5*	210.0*	10.0	30.0
Iron (ug/l)	3,435.2*	33,500.0*	260.0	1,000.0
Lead (ug/l)	21.3	225.0*	2.0	30.0
Nickel (ug/l)	79.3	100.0	30.0	----
Zinc (ug/l)	64.9	640.0*	10.0	130.0
Manganese (ug/l)	178.3	555.0	85.0	----
Aluminum (ug/l)	283.3	600.0	200.0	----
Chloride (mg/l)	102.5	212.0	2.3	----
Sulfate (mg/l)	84.3	116.0	66.0	----
Cyanide (mg/l)	0.1*	3.8*	0.01	0.025

*exceeds State of Ohio water quality standard

SOURCE: OEPA, STORET Retrieval Data, 6 December 1983.

g. Air Quality.

The project area lies within the Cleveland Air Quality Control Region (AQCR). Boundaries for each AQCR are set by consideration of air pollution levels, population density, geography, and common meteorological conditions. In

1982, a total of 117 ambient air quality monitors were operated in the Cleveland AQCR measuring the following criteria pollutants: total suspended particulates (TSP); lead; sulfur dioxide (SO₂); oxides of nitrogen; carbon monoxide (CO); ozone (O₃). (NOTE: The majority of the air quality monitoring stations (AQMS) are located within the city of Cleveland. Since Independence and Valley View are located outside of this primarily commercial-industrial setting, pollutant levels can be expected to be correspondingly lower).

According to OEPA's Ohio Air Quality 1982, the short-term (24 hour) air quality standard for TSP was exceeded on 5 days in 1982. The short-term (24-hour) standard for SO₂ was exceeded on 1 day, the short-term (8-hour) standard for CO was exceeded on 4 days, and the short-term (1-hour) standard for O₃ was exceeded on 6 days.

The 1982 TSP highest annual geometric mean concentration for Cuyahoga County was 101 ug/m³ which is above the primary standard of 75 ug/m³. The SO₂ highest annual arithmetic mean concentration was 41 ug/m³ which is below the primary standard of 80 ug/m³. The NO₂ highest annual mean concentration was 56 ug/m³ which is below the primary standard of 100 ug/m³. According to OEPA, 1982 air quality standard violations were recorded in Cuyahoga County for TSP (primary standard) and ozone. The AQMS nearest the project area - Parma, OH (approximately 5 miles northwest of Valley View) - recorded no violations in 1982.

9. BIOLOGICAL ENVIRONMENT

a. Fish.

Sixty-eight species of fish were known to occur in the Cuyahoga River mainstream before 1950. Currently, few fish can survive the chronic organic pollution and frequent toxic conditions which characterize the river below Akron. According to the U.S. Department of Interior, Bureau of Outdoor Recreation, the river no longer constitutes a viable fishing resource. Investigations in 1971 and 1972 by Dr. Andrew White of John Carroll University included samplings at Rockside Road and the base of Cuyahoga Falls in Peninsula, OH. Fishes collected included the white sucker, golden shiner, emerald shiner, blacknose dace, creek chub, silverjaw minnow, fathead minnow, stoneroller, goldfish, stickleback, green sunfish, bluegill, and black bullhead. The physical appearance of several of these fish indicated that they represented a true riverine population and were not accidental strays washed into the river from adjacent lakes, ponds, or tributaries. Most fishes collected were hardy species with rather broad ranges of tolerance. This represents a change from earlier 1968 studies in which no fish at all were recorded below Akron.

b. Wildlife.

The Cuyahoga River Valley supports diverse and numerous fauna (a total of 310 species). From Rockside Road on the north to the city of Akron on the south, the Cuyahoga Valley is estimated to include 23 species of amphibians, 18 species of reptiles, and 41 species of mammals. The bird fauna consists of 59 species that are permanent residents or that occur in the region

throughout the year, and 169 species that are transients, visitors, or seasonal residents (U.S. Department of the Interior, 1976).

The banks of the Cuyahoga River at Site 4 are heavily vegetated with trees, shrubs, and herbaceous vegetation. According to the USFWS (26 September 1985), several good denning trees and snags have been noted along Stone Road between Stone Road Bridge and Canal Road. In addition, the area has excellent cover and nesting habitat. In a relatively short period, a USFWS biologist surveying the site observed cardinal, downy woodpecker, black-capped chickadee, red-winged blackbird, mallard (on the river), song sparrow, English sparrow, tufted titmouse, fox squirrel, and woodchuck (USFWS, 24 May 1985).

c. Threatened and Endangered Species.

The proposed project sites are within the range of the following Federal endangered species:

<u>Name/Status</u>	<u>Habitat</u>	<u>Distribution</u>
Indiana bat <u>Myotis sodalis</u>	Caves and riparian	Statewide, except Athens, Belmont, Carroll, Coshocton, Gallia, Guernsey, Harrison, Jackson, Jefferson, Lawrence, Meigs, Monroe, Morgan, Muskingum, Noble, Tuscarawas, Vinton, and Washington Counties.

To date, no critical habitat for this species has been identified within the project area. Consultation with the Ohio Department of Natural Resources, Division of Natural Areas and Preserves has identified no records of rare or endangered species within the proposed project sites.

10. HUMAN ENVIRONMENT

a. Land Use.

Within the city of Independence and village of Valley View, land use is mixed residential, commercial, industrial, and recreational. In Independence, 1,091 (17.7 percent) acres are residential, 626 (10.2 percent) acres are recreational, 364 (5.9 percent) acres are industrial, 86 (1.4 percent) acres are commercial, and 959 (15.6 percent) acres are other uses. Over 49 percent of the total land area is undeveloped (city of Independence, 1980). In Valley View, 1,993 (50 percent) acres are residential, 1,595 (40.0 percent) acres are industrial, 311 (7.8 percent) acres are recreational, and 88 (2.2 percent) acres are commercial (Cleveland Regional Sewer District, 1976).

Within the proposed project area, land use at Sites 1 and 3 is primarily commercial/industrial; at Sites 2 and 4 land use is primarily residential.

b. Demography.

With a 1980 population of 1,498,400, Cuyahoga County is the largest county in Ohio. About 38 percent of its population resides in the city of Cleveland. Independence and Valley View had a total population of 8,183 in 1980. The population of Independence decreased from 7,034 in 1970 to 6,607 in 1980 (a decrease of 6.1 percent), while the population of Valley View increased from 1,422 in 1970 to 1,576 in 1980 (an increase of 9.8 percent). Table 2 presents, in comparative form, basic demographic data for the project area.

c. Housing and Structures.

In 1980, the number of occupied housing units in Cuyahoga County was 563,478 (39 percent renter-occupied). In Independence, there were 2,184 (7 percent renter-occupied) housing units and, in Valley View, there were 492 (14 percent renter-occupied) housing units. Median value of owner-occupied noncondominium housing units was \$53,200 for Cuyahoga County, \$72,400 for Independence, and \$68,000 for Valley View (1980 Census of Population and Housing). A total 39 commercial/industrial structures are present in the project area. A total of 106 housing units are present in the four project sites.

Table 2 - Comparative Demographic Data

	: State of : Ohio	: Cuyahoga : County	: City of : Independence	: Village of : Valley View
Total Population	: 10,797,600	: 1,498,400	: 6,607	: 1,576
Percent Female	: 51.7	: 52.7	: 52.0	: 50.3
Percent Non-white	: 11.1	: 24.4	: 0.9	: 0.1
Percent Over 60	: 15.4	: 18.3	: 23.3	: 12.4
Percent Under 20	: 32.4	: 29.3	: 25.6	: 33.9
Median Age	: 34.0	: 36.2	: 41.2	: 31.5

SOURCE: 1980 Census of Population and Housing

d. Business and Industry.

The Cleveland, OH, SMSA is a diversified durable goods manufacturing area. In 1980, 255,000 persons in the four-county SMSA were employed in manufacturing. This was about 28 percent of the 905,000 persons employed in the area; in the U.S. as a whole, less than 22 percent of total employment was in the manufacturing sector. The five largest industries in metropolitan Cleveland are: Manufacturing (except Electrical): Fabricated Metal Products: Primary Metal Industries; Transportation Equipment: and Electrical and Electronic Equipment. The largest nonmanufacturing categories were Services

(187,000 persons; 20.7 percent of the total employment); Retail Trade (146,000; 16.1 percent); and Government (122,600; 13.5 percent) (Greater Cleveland Growth Association, 1983).

Sites 1 and 3 are commercial/industrial sites within the study area. A total of 28 businesses currently operate within the two sites.

e. Employment and Income.

In 1980, the two largest general categories of employers in Cuyahoga County were the service industries which employed 29.3 percent of the total work force and the manufacturing industries, which employed 28.7 percent of the labor force. The current unemployment rate for Cuyahoga County is about 9 percent.

In 1980, median household income for Cuyahoga County was \$18,009, or about 101 percent of the State median of \$17,754. In 1980, 11.3 percent of all persons residing in Cuyahoga County were below the poverty level, compared to the State level of 10.1 percent.

f. Transportation.

Highway access to Independence from Cleveland to the north and Akron to the south is provided by two major interstate highways, I-77 (Willow Freeway) and I-480. Major east-west routes through the city are Granger Road (SR17), Rockside Road, and Pleasant Valley Road. Canal Road (SR631), which follows the Ohio Canal, is the major north-south vehicular transportation route through Valley View. Granger Road (SR-17), Rockside Road, Schrieber Road, Tinkers Creek Road, and Pleasant Valley Road provide east-west passage through the village.

Francis Drive, Charles Drive and Gleeson Road service the residential subdivision at Site 4. Francis and Charles Drives have outlets at both Stone Road and Canal Road. Gleeson Road forms a dead end off Canal Road. Stone Road crosses the Ohio Canal and the Cuyahoga River and enters the city of Independence. Stone Road Bridge across the Cuyahoga has been abandoned since 1982.

The Chessie System Railroad, Norfolk and Western Railway, and Conrail are the three major trunk line railroads that serve the Cleveland metropolitan area. The Newburgh and South Shore Railroad, Cuyahoga Valley Railway, and River Terminal Railway operate switching lines. A major trunk line of the Chessie System Railroad follows the Cuyahoga River from Cleveland to Akron through the city of Independence. A spur line of the South Shore Railroad enters Site 1 from Cleveland.

The nearest air transportation terminals are the Cleveland-Hopkins International Airport and the Burke Lakefront Airport in Cleveland. The Burke Lakefront Airport is used primarily for short, regional flights, while the larger Cleveland-Hopkins terminal is used by the major airlines for long-distance air travel.

g. Utilities.

The Cleveland Regional Sewer District is in the process of planning interceptors that would eventually service the project area. The Cleveland Water Department with water lines on the east side of the Cuyahoga Valley serves the area as far south as Northfield Center Township. Natural gas is provided to the area by the East Ohio Gas Company which supplies gas fuel to an area of some 2,500 square miles, and has over 930,000 customers. The Ohio Bell Telephone Company provides telephone service to over 3.6 million people, including the project area. Electricity is provided to the area by the Cleveland Electric Illuminating Company.

h. Public Services and Facilities.

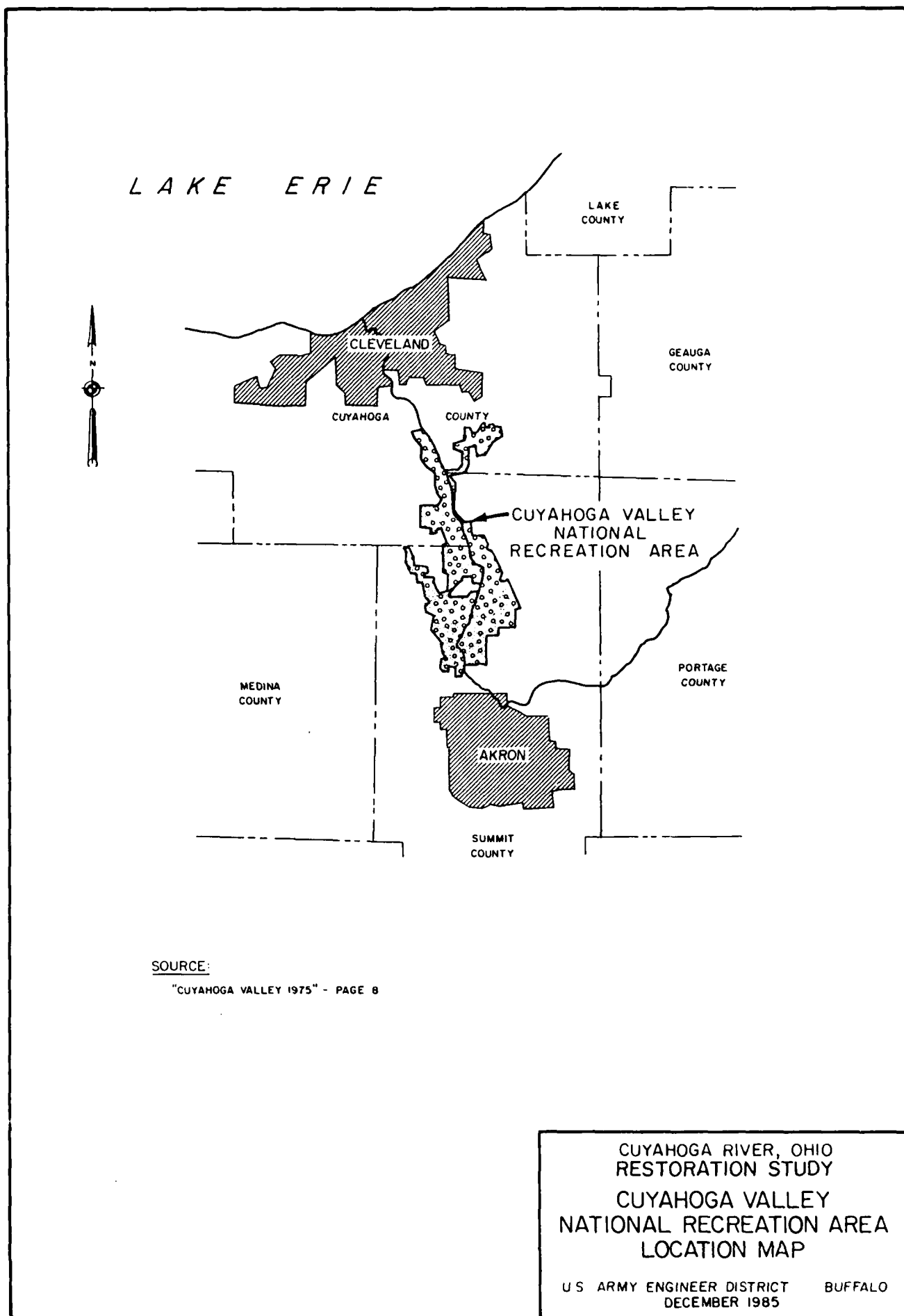
The city of Independence has a new fire station and equipment manned by 11 full-time firefighters, 7 of whom are trained paramedics, and 27 volunteers. There are 17 full-time patrolmen and 4 deputies in the police department. The village of Valley View has 3 full-time plus 20 part-time firefighters, and 8 full-time plus 5 part-time policemen. The Village Hall is located immediately southeast of Site 4.

i. Recreational Resources.

In the late 1960's, the State of Ohio and the Cleveland and Akron Metropolitan Parks Districts initiated efforts to acquire property in the Cuyahoga Valley. As a result of these efforts to preserve the valley, the Cuyahoga Valley National Recreation Area (CVNRA) was established in 1974 by Public Law 93-555 "for the purpose of preserving and protecting for public use and enjoyment, the historic, scenic, natural, and recreational values of the Cuyahoga River and the adjacent lands of the Cuyahoga Valley and for the purpose of providing for the maintenance of needed recreational open space necessary in the urban environment..." Management of the CVNRA is the responsibility of the National Park Service.

The recreation area extends from Rockside Road on the north to the city of Akron on the south and includes 32,000 acres within its authorized boundaries (see Figure 3). In 1983, attendance at the various CVNRA facilities was estimated at 4.6 million visits. Site 4 borders the Canal Unit which contains some of the major historic resources of the valley. The watered portion of the Ohio and Erie Canal and associated locks and structures is the main focus of this unit. The primary theme for the management of the Canal Unit is the history of settlement, growth and change, with secondary themes including natural history, history of transportation and active recreation (canoeing, picnicking, towpath hiking, excursion train rides and cross-country skiing).

According to the National Park Service, two of the four project sites affect the National Recreational Area. Site 3 adjoins the northern boundary and could affect potential access to the park from Old Rockside Road. Site 4 includes about 35 acres within the park, of which 8 acres (including the Canal Visitor Center at 6699 Canal Road) are Federally owned.



j. Cultural Resources.

The Cuyahoga River Valley is one of Ohio's most significant archaeological resources. Almost every bluff along the river has evidenced signs of prehistoric occupation. Major sites exist on the flood plain and important type sites have been found on surrounding uplands.

In 1975, an archaeological survey of the Lower Tinkers Creek area was conducted by Dr. David Brose of the Cleveland Museum of Natural History. This survey discovered a number of archaeological sites in the area including four within Site 4. According to the Ohio Historic Preservation Office (OHPO), "...information on these sites indicate that (a) wide variety of cultural resources are present in the project area. Furthermore, the context of at least some of these sites is such that they are quite probably eligible for listing on the National Register of Historic Places. There currently is listed a National Register District, the Terra Vista Prehistoric District, which is located south of the (proposed) protection area in (the) Valley, on the north side of the confluence of Tinkers Creek and the Cuyahoga River." On this basis, OHPO recommended that a cultural resources reconnaissance survey of the project area be undertaken. This reconnaissance survey was conducted in the summer/fall of 1985.

The Cuyahoga River Valley was also an important transportation route and focus for early settlers. The Ohio and Erie Canal ran from Cleveland south along the Cuyahoga over the Old Portage and down the Tuscarawas and the Muskingum Rivers to the Ohio River. The entire canal was 308 miles in length and had 148 locks and 14 aqueducts. The first section opened (between Cleveland and Akron) allowed boats to travel 37 miles (and 400 feet in elevation) between the lake and the summit. Today, the Valley View section of the canal (including locks 37, 38, and 39), the Tinkers Creek Aqueduct, Wilson's Mill (also known as Alexander Mill) are listed on the National Register of Historic Places (National Park Service, 1976).

SECTION III

PROBLEM IDENTIFICATION

The purpose of this section is to inform the reader of the water and related resource problems and needs in the study area and for which this study seeks a solution. The section discusses the need to reduce flood damages in the Valley View/Independence area; reviews the planning constraints under which this study was conducted; discusses the specific planning objectives of the study; and reviews the conditions that would exist if no Federal action was taken.

11. PROBLEMS AND NEEDS

a. Flooding in the Valley View/Independence Area

As previously discussed, the Second Interim Study investigated the feasibility of providing flood protection measures in the lower reach of the Cuyahoga River from river mile 5.8 to river mile 18.8 which includes the Valley View/Independence area. Types of protection measures considered included channelization, reservoirs, and floodproofing, all providing protection for the entire reach of the river. However, no plan was economically feasible and the study was terminated in 1976.

Subsequent to completion of the Second Interim Study, local residents in the Valley View/Independence area requested that smaller-scale flood control measures, such as minor channelization, clearing and snagging, debris removal, and/or ring levees be investigated for areas within their communities where high flood damages occur. However, they did not identify the location of these high damage areas. Therefore, the first step in the study process was to identify these high damage areas and to define the extent of the flood damages.

On 14 September 1979, flooding, with an estimated average recurrence interval of once in 40 years, occurred in the Valley View/Independence area, causing an estimated \$3 million in flood damages. Aerial photographs during the maximum extent of the flooding were taken by the Ohio Department of Natural Resources and are provided as Plates 1-6. An examination of these photographs indicates significant concentrations of structures experiencing flooding in four areas. They are:

- (1) Site 1, primarily a commercial/industrial area, at river mile 11.5, north of Granger Road and west of the Willow Freeway (see Plates 2 and 3).
- (2) Site 2, primarily a residential area, at river mile 12.9, to include the Fosdick, Murray, Heinton Road area (see Plates 3 and 4).
- (3) Site 3, primarily a commercial/industrial area, at river mile 13.8, north of Rockside Road and adjacent to the west bank of the Cuyahoga River (see Plate 4).

(4) Site 4, primarily a residential area, at river mile 15.3, to include the Francis and Charles Drive and Gleeson Road area (see Plate 5).

All other flooded reaches within the Valley View/Independence area either did not contain any structures (and thus flood damages were minor), or, if there were structures present, they were isolated and potential flood damage reduction benefits in these areas would not be of sufficient magnitude to support a flood control project. Therefore, the first conclusion reached in the study was to limit the remainder of the effort to these four specific high damage areas and to eliminate all other areas from further consideration.

Flood outlines and flood profiles under existing conditions for various storm events were developed by Buffalo District personnel. Flood outlines depict the overall extent of the flooding, and flood profiles indicate the water surface elevation. The results of this analysis for the 50-year and 100-year storm events are shown on Plate 7. The boundaries for the four areas still under consideration (i.e., Sites 1-4) are also outlined on this plate.

With the location of the four high damage areas established, a preliminary survey was conducted by Buffalo District personnel in the spring/summer of 1982 augmented by additional, detailed field work in the spring/summer of 1985 to define the extent of the existing flood damages. Table 3, following, summarizes existing flood damages to these areas. As indicated, average annual flood damages range from about \$35,700 for Site 2, \$43,700 for Site 4, \$52,700 for Site 1, to a high of about \$94,000 for Site 3 (July 1985 price levels).

Table 3 - Estimated Flood Damages, Sites 1-4
(July 1985 Price Levels)

Flood Event (Frequency of Occurrence)	Estimated Existing Flood Damages (1)			
	Site 1 (1)	Site 2 (1)	Site 3 (1)	Site 4(2)
	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)
5-year	0.5	21.7	0	6.7
10-year	5.6	88.8	4.3	101.7
25-year	141.9	214.6	381.1	252.5
50-year	923.0	401.9	1,685.4	505.6
100-year	2,009.1	602.7	2,998.7	876.9
500-year	3,787.4	1,468.2	6,874.6	2,210.8
Average Annual	52.7	35.7	94.0	43.7(2)

- (1) Based on preliminary data updated from April 1982 price levels to July 1985 price levels.
- (2) Based on additional field data obtained during the detailed planning phase.

b. Other Water Resources Problems Not Considered

The study categories of water quality, environmental quality, recreation, fish and wildlife, and flood control listed in the 1970 study authorization

are very broad and interrelated. For this reason, it is necessary to subdivide these categories into eight specific water-related resource problems. These eight specific problems are as follows: water quality, recreation, water supply, flood control, erosion and sedimentation, debris removal, fish and wildlife, and aesthetics.

The primary objective of the Final Report is to determine the feasibility of reducing flood damages at four specific sites in the Valley View/Independence area. The rationale for not addressing the remaining basin problems in this report are as follows:

(1) Water Quality - The Northeast Ohio Areawide Coordinating Agency is currently involved in a Section 208 Study (Public Law 92-500) in the Cuyahoga River Watershed. The goal of this study is to identify development and management water quality programs that would control point and nonpoint sources of pollution, thereby reestablishing and maintaining the highest practical water quality in the Cuyahoga River Basin. To avoid duplication of effort, no further consideration was given to this aspect under the CRRS.

(2) Recreation - Various Federal, State, and local agencies are currently involved in recreational planning and implementation in the Cuyahoga River Watershed. Of particular importance are the activities of the State of Ohio - Cleveland Metropolitan Parks Department, Akron Metropolitan Park District and Ohio Department of Natural Resources - and the National Park Service under their management of the Cuyahoga Valley National Recreation Area. Thus, since other Federal, State, and local agencies have taken the lead in meeting both the immediate and long term recreation needs of the area, further study under the CRRS is not warranted.

(3) Water Supply - The problems associated with providing a sufficient supply of water for present and future needs of the Cuyahoga River Basin have been addressed by the Ohio Department of Natural Resources in their 1972 Northeast Ohio Water Development Plan. Therefore, there is no need to study this problem under the CRRS.

(4) Flood Control - The remaining flood problems in the basin were addressed in previous reports for this study (i.e., the First Interim Report addressed flooding along Big Creek and the Second Interim Report addressed the remaining flood problems in the basin).

(5) Erosion and Sedimentation - Addressed in the Third Interim Report for this study.

(6) Debris Removal - Will be addressed in the Final Report as an alternative measure to reduce flood damages in the Valley View/Independence area.

(7) Fish and Wildlife - Since there is no current interest on the part of other Federal, State, or local agencies to address this need under the CRRS, no further consideration was given to this aspect. However, although this need will not be considered separately, all alternatives formulated for the Final Report will be discussed and coordinated with the U.S. Fish and

Wildlife Service to assure that any required mitigation is incorporated into the considered alternatives.

(8) Aesthetics - Since there is no current interest on the part of other Federal, State, or local agencies to address this need under the CRRS, no further consideration was given to this aspect. However, all alternatives formulated for the Final Report will give full consideration to enhancing the physical environment, where possible.

12. PLANNING CONSTRAINTS

As previously discussed, the primary objective of the Final Report is to determine the feasibility of reducing flood damages at four specific locations in the Valley View/Independence area (i.e., Sites 1-4). Site 4, however, is located partially within the boundaries of the Cuyahoga Valley National Recreation Area (CVNRA) and several of the Park's management policies impacted on the formulation of alternative plans to reduce flood damages at this site. These policies, as listed in the National Park Service's "General Management Plan", July 1977, are as follows:

a. Environmentally compatible methods will be employed to restrain and retard the inevitable erosional and depositional transformation of the valley due to ever-increasing stormwater runoff and periodic flooding. Wherever possible, natural processes will be allowed to continue uninterrupted.

b. The restoration or repair of riverbanks in the valley for the purposes of erosion and sedimentation control will be undertaken only where consulting experts indicate that such actions are necessary to offset past damage caused by human activities or that excessive erosion, siltation, and sedimentation may impair the achievement of water-quality standards.

c. If any existing impoundments, diversion channels, or canal walls open naturally, the effects on the river basin ecosystem and the regional economy, as well as other relevant factors, will be immediately evaluated. Appropriate authorities will be encouraged to close such breaches if adverse impacts are determined to outweigh benefits derived.

d. No new dams or diversions will be constructed or channelization undertaken within the park boundary.

Additionally, the National Park Service also stated their concern regarding construction or changes in topography at Site 4 adversely affecting the Ohio and Erie Canal's scenic character. (Note: The canal is located immediately west of Site 4 -see Plate 7.)

Throughout the course of this study, every attempt was made to ensure that alternatives formulated to reduce flood damages at Site 4 were compatible with the stated policies and concerns of the National Park Service. In those cases where this was not possible, such as levee plans which would adversely affect the aesthetics of the area, these adverse impacts were kept to a minimum. Further, the policies and concerns of the National Park Service were given significant weight in the evaluation of alternative plans.

13. NATIONAL OBJECTIVE

Current Federal policy, as developed by the President's Water Resources Council, requires that alternative water and related resource plans be formulated in accordance with the national objective of National Economic Development (NED). National Economic Development is achieved by increasing the value of the nation's output of goods and services and improving economic efficiency consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements. Therefore, in accordance with the guidance established in Engineering Regulation 1105-2-30, "General Planning Principles", dated 18 October 1985, this study was consistent with the planning requirements of the Water Resources Council "Principles and Guidelines" (P&G) and related policies.

14. SPECIFIC PLANNING OBJECTIVES

Specific planning objectives are the national, State, and local water and related land resources management needs (opportunities and problems) specific to a study area that can be addressed to enhance National Economic Development. Based on a review of the directives established by the authorizing legislation for the Cuyahoga River Restoration Study, previous reports for the area, statements by individuals in the private sector, input from officials at many levels of Government, and an analysis of the problems and needs of the study area, as discussed previously, the specific planning objectives for this Final Report that have been identified are as follows:

(1) Enhance National Economic Development by reducing flood damages at four specific sites in the Valley View/Independence area (i.e., Sites 1-4).

(2) Insure that proposed flood control plans minimize, to the fullest extent possible, adverse impacts to the CVNRA.

15. CONDITIONS IF NO FEDERAL ACTION TAKEN (WITHOUT PROJECT CONDITIONS)

In any formulation, there is always the basic question . . . "Is there a justified need for change?" Therefore, the conditions that would exist if no Federal action were taken was investigated for this study. Besides answering the basic question, these conditions will also provide a common basis for comparing alternative plans of improvement.

As a result of no action, flooding at Sites 1-4 in the Valley View/Independence area would continue, with average annual damages totaling about \$230,000. However, since no new development is projected for these areas due to the severe flooding problem, flood damages should not increase. As a result of no Federal action, the trauma and inconvenience experienced by flood victims in these four areas would also continue. Further, during flood events, sediment and other pollutants would continue to be washed into the Cuyahoga River.

If no Federal action were taken, there would be no need for the monetary investment that would be required to reduce flood damages at Sites 1-4. No Federal action would also result in no disturbance of the existing environment. The possibility of adverse impacts to the CVNRA would also be eliminated.

SECTION IV PLAN FORMULATION

The purpose of this section is to provide a summary of the plan formulation planning effort conducted for this feasibility study. The section provides: a brief review of the alternatives addressed in the 1976 2nd Interim Report; summarizes events necessitating that flood control measures be reevaluated for the Valley View/Independence area; discusses the formulation methodology used in this evaluation; and discusses the development of preliminary and detailed alternative plans.

16. PLAN FORMULATION RATIONALE

a. Alternatives Addressed in the 2nd Interim Report (1976).

Three general types of measures to reduce flood damages in the lower Cuyahoga River Basin (from river mile 5.8 to river mile 18.8) were addressed in the 2nd Interim Report: reservoirs; floodproofing and zoning regulations; and local protection. Reservoirs were eliminated from further consideration early in the study because they were not compatible with the deteriorated water quality of the lower river nor with the intended purpose of the Cuyahoga Valley National Recreation Area. In addition, based on a cursory examination, it did not appear that a reservoir project would be economically feasible because of the large first cost of the reservoir project in comparison with the magnitude of the potential benefits resulting from such a project. Similarly, floodproofing measures, which are designed to reduce flood damages although the area is still flooded, were also eliminated early in the study. This was because the various types of activities present in the area require vast open areas (trucking freight companies, drive-in theaters, lumber yards, etc.) and floodproofing measures were found to be costly and locally unappealing. Thus, floodproofing was neither economically feasible nor locally acceptable and was dropped from further consideration. However, it was recommended that local communities adopt flood plain zoning regulations to prevent increased flood damages in the area.

The only flood control alternatives addressed in detail for the Lower Cuyahoga River were two local protection projects. These projects included channelizing 6.5 miles of the lower river and modifying/reconstructing several bridges which tend to create jams and constrict flow. One plan was designed to provide protection from a 50-year flood and the other was designed to provide protection from a 100-year flood. However, with costs of about \$13.5 million and \$14.5 million (April 1975 price levels) and annual benefits of only about \$477,000 and \$490,000, respectively, the resulting benefit-cost ratios were significantly below 1.0 (i.e., 0.56 and 0.55). Further, since neither plan was economically justified, they were also dropped from further consideration. Therefore, one conclusion of the 2nd Interim Study was that there was no Federal interest in reducing flood damages in the Lower Cuyahoga River Basin.

b. Need to Reevaluate Flood Control Measures in the Valley View/Independence Area.

The need to reevaluate the feasibility of reducing flood damages in the Valley View/Independence area was discussed in previous sections of this Main Report. In summary, flood control plans analyzed in the 2nd Interim Report concentrated on providing protection for the entire Lower Cuyahoga River Basin (i.e., regional plans). However, no plan was economically justified, and the study was terminated. Subsequent to completion of the 2nd Interim Report, local residents requested that smaller-scale flood control measures, such as minor channelization, clearing and snagging, debris removal, and/or ring levees be investigated for areas within their communities where high flood damages occur. Based on subsequent analysis, the scope of the study was further reduced to four specific locations within the Valley View/Independence area (i.e., Sites 1-4).

Investigation of other water resources problems and needs, such as recreation, water quality, water supply, fish and wildlife resources, aesthetics, and erosion and sedimentation was limited to a level of refinement necessary to adequately assess potential impacts on each by proposed modification plans.

17. GENERAL FORMULATION AND EVALUATION CRITERIA

Federal policy on multiobjective planning, derived from both legislative and executive authorities, establishes and defines the national objective for water resource planning, specifies the range of impacts that must be assessed, and sets forth the conditions and criteria which must be applied when evaluating plans. Plans must be formulated to meet the needs of the area with due regard to benefits and costs, both tangible and intangible and effects on the ecology and social well-being of the community.

The formulation of a plan, including the screening of alternatives, must of necessity be within the context of an appropriate framework and set of criteria. The planning framework is established in the Water Resource Council's "Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies," which requires the systematic preparation and evaluation of alternative solutions to problems, under the objective of National Economic Development (NED). The process also requires that the impacts of a proposed action be measured and the results displayed or accounted for in terms of contributions to four accounts: NED, Environmental Quality (EQ), Regional Economic Development (RED), and Other Social Effects (OSE). The formulation process must be conducted without bias as to structural and nonstructural measures.

Within the structure of the overall planning framework other more specific criteria relative to general policies, technical engineering, economic principles, social and environmental values, and local conditions must be established. These criteria, noted as "Technical," "Economic," and "Socioeconomic and Environmental" are as follows:

a. Technical Criteria.

- (1) Levees will include 3 feet of freeboard over and above the design flood stage.
- (2) Assume that levee sideslopes of 2.5:1 are adequate for all aspects of functional design.
- (3) Standard Project Flood (SPF) Plan will not be evaluated because flooding is not of a catastrophic nature. The effects of the SPF, however, will be evaluated for the recommended plan, as warranted.

b. Economic Criteria.

- (1) Tangible benefits should exceed project economic costs.
- (2) Each separable unit of improvement or purpose should provide benefits at least equal to its cost unless justifiable on a noneconomic basis.
- (3) Each plan, as ultimately formulated, should provide the maximum net benefits possible within the formulation framework.
- (4) The costs for alternative plans of development should be based on preliminary layouts, estimates of quantities, and comparable unit prices.
- (5) The benefits and costs should be in comparable economic terms to the fullest extent possible.
- (6) A 50-year economic life is used for the economic evaluation.
- (7) The project evaluation period is a 50-year interval beyond the estimated implementation date of 1992.
- (8) The base case for comparison of alternative plans is the do-nothing ("no-action") plan.
- (9) For levee plans, the level of protection for benefit evaluation will include one-half of the total freeboard (i.e., one-half of 3 feet, or, 1-1/2 feet).
- (10) For flood plain relocation plans, assume that all structures that can be physically relocated will be relocated. Additionally, the relocation site will be within a 5-mile radius of the present site.

c. Socioeconomic and Environmental Criteria.

The criteria for socioeconomic and environmental considerations in water resource planning are prescribed by the National Environmental Policy Act of 1969 (PL 91-190) and Section 122 of the River and Harbor Act of 1970, (PL 91-611). These criteria prescribe that all significant adverse and beneficial economic, social, and environmental effects of planned developments be considered and evaluated during plan formulation.

d. Design and Other Considerations.

(1) For levee plans considered assume that: (a) an acceptable borrow area that contains suitable semi-impervious material is within a 10-mile radius of the construction site; and (b) foundation material at the proposed levee site will not present underseepage problems.

(2) Excavated Material Disposal - Assume that excavated material from levee construction will be placed in nearby open fields that are less than 1 mile from the construction site. A sufficient amount of contingency and cost is included in the cost estimates for landscaping and reseeding the spoil disposal areas.

(3) Cost Sharing - The Secretary of the Army is reviewing project cost-sharing and financing across the entire spectrum of water resources development functions. The basic principle governing the development of specific cost-sharing policies is that whenever possible, the cost of services produced by water projects should be paid for by their direct beneficiaries. Although only the traditional cost-sharing is presented here, the reader should be aware that other ratios may be required by the Secretary of the Army before approving construction.

(a) Local Protection (Structural) - Federal responsibilities include 100 percent of the construction costs for the flood control project. Non-Federal interests are required to provide all lands, easements, and rights-of-way: relocate all utilities; and maintain the completed project.

(b) Non-Structural - Federal responsibilities include 80 percent of the total project cost (construction cost, lands, easements and rights-of-way and utility relocations). Non-Federal responsibilities include 20 percent of the total project cost and maintaining the completed project.

(4) Local Sponsor - Formal assurances of local cooperation must be furnished by a municipality or other public agency fully authorized under State laws to give such assurances and financially capable of fulfilling all items of local cooperation. At the present time, the Cuyahoga County Commissioners have indicated their intent to become the local sponsor for a flood control project in the Valley View/Independence area and provide all items of local cooperation.

18. DEVELOPMENT OF PRELIMINARY ALTERNATIVE PLANS (POSSIBLE SOLUTIONS)

a. General.

Within the prescribed planning framework and established criteria, possible solutions were identified and evaluated in a two phase iterative process to address the needs of the study area and the overall planning objectives. Each phase included the four functional planning tasks of problem identification, formulation of alternatives, impact assessment and evaluation. Each phase contained essentially the same sequence of tasks but emphasis shifted as the process proceeded.

This paragraph presents the results of the preliminary planning phase. The level of study performed is consistent with the preliminary planning objective of evaluating a broad range of possible solutions and identifying the best general plan (or plans) for satisfying the flood control needs at four specific sites in the Valley View/Independence area (Sites 1-4) for further, detailed study.

The primary water resources need for which a solution is sought under this authority is to reduce flood damages at four specific sites in the Valley View/Independence area (Sites 1-4). As possible solutions to addressing this need, 25 preliminary alternatives, in addition to the "No Action" option, were initially formulated and assessed. These alternatives fall into three broad categories: levee protection plans; floodproofing; and flood plain relocation. These categories are discussed below in general terms.

(1) Levee Protection Plans - At each site, a minimum of two levee protection plans were formulated: one would provide protection from a 100-year flood and the other would provide protection from a 50-year flood. In both cases, the proposed levee system would prevent flooding within the site up to the design storm event; however, the areas outside the site would still become flooded. At Site 4, several additional levee plans were also formulated which involved various combinations of the following three items: (1) removing the abandoned Stone Road bridge which restricts the flow of the river (see Plate 7); (2) straightening the river just upstream of the Stone Road bridge (from station 740+00 to 760+00); and/or (3) removing the gravel bar in the river just downstream of the Stone Road bridge, (station 730+00). In this manner, the height of the proposed levee at Site 4 could be reduced while providing the same degree of protection. Further, since removing the Stone Road bridge had the greatest effect of the three items in reducing flood damages at Site 4, an additional plan was formulated which included just this one item. It should be noted, however, that for all levee protection plans, no consideration was given to internal flood control within the site nor to diverting overland flow originating from outside the site. These two items were addressed in the detailed planning phase on those levee protection plans carried forward for further detailed analysis.

(2) Floodproofing Plans - At each site, two floodproofing plans were formulated; one would provide protection from a 100-year flood and the other would provide protection from a 50-year flood. In both cases, structures within the sites would be modified such that flood damage to the structure and/or contents is minimized even though the site itself is still flooded. In general, this required that the structure either be sealed, to prevent flood water from entering, or that contents within the structure be raised above the level of flooding.

(3) Relocation Plans - Relocation plans developed during the preliminary planning phase involved removing all residential structures from the flood plain and converting the vacated land to recreational use. This method is not applicable, however, to commercial structures since part of their business is based on their location. Thus, relocation plans were only developed for Sites 2 and 4, which are primarily residential areas but were not developed for Sites 1 and 3 which are primarily commercial sites. Again, two

relocations plans were developed at each site; one plan removed all residential structures within the 50-year flood plain and the other plan removed all residential structures within the 100-year flood plain.

It should be noted from the above discussion that no plans were developed that involved clearing and snagging. This was because there were no areas along the river where concentrations of brush, debris, ect., existed which would effect the flow of the river. Thus, there is no need to consider such plans at the present time.

b. Assessment, Evaluation, and Comparison of Preliminary Plans.

Table 4, following, provides a brief description of the 25 preliminary plans formulated to reduce flood damages at four sites in the Valley View/Independence area (Sites 1-4) along with their estimated costs. The table also compares the economic and environmental impacts of these 25 plans. The basis of comparison is the "No-Action" (do-nothing) plan. For additional details, the reader is referred to the "Cuyahoga River, Ohio Restoration Study - Preliminary Feasibility Report on Flood Control in the Valley View/Independence Area", February 1984 (Revised April 1984).

c. Rationale for selecting plans for further detailed study (Plans 3A, 4A, and 4G)

The primary consideration used in selecting those plans to carry forward into the detailed planning phase was economic efficiency. As such, only those plans that had benefit-to-cost ratios greater than 1.0 were carried forward. These plans were Plans 3A, 4A, and 4G with benefit/cost ratios of 1.0, 1.0 and 1.5, respectively.

d. Rationale for eliminating plans from further consideration (Plans 1A, 1B, 1C, 1D, 2A, 2B, 2C, 2D, 2E, 2F, 3B, 3C, 3D, 4B, 4C, 4D, 4E, 4F, 4H, 4I, 4J, and 4K)

The primary consideration used in selecting those plans to eliminate from further consideration was economic efficiency. As such, all plans with benefit-to-cost ratios less than 1.0 were dropped from further consideration. These plans were Plans 1A, 1B, 1C, 1D, 2A, 2B, 2C, 2D, 2E, 2F, 3B, 3C, 3D, 4B, 4C, 4D, 4E, 4F, 4H, 4I, 4J, and 4K with benefit/cost ratios of 0.7, 0.5, <0.5, <0.9, 0.3., 0.3, <0.4, <0.4, 0.7, 0.7, 0.8, <0.2, <0.2, 0.9, 0.4, 0.4, 0.8, 0.8, <0.7, <0.8, 0.9, and 0.9 respectively.

Table 4 - Assessment, Evaluation, and Comparison of Preliminary Plans

Item	Alternative Plan 1A		Alternative Plan 1B		Alternative Plan 1C		Alternative Plan 1D	
	(100-Year Levee Protection - See Plate 8)	(50-Year Levee Protection - See Plate 8)	(100-Year Levee Protection - See Plate 8)	(50-Year Levee Protection - See Plate 8)	(100-Year Levee Protection - See Plate 8)	(50-Year Levee Protection - See Plate 8)	(100-Year Levee Protection - See Plate 8)	(50-Year Levee Protection - See Plate 8)
1. Plan Description	<p>This plan consists of constructing a levee along the east bank of the unnamed creek that flows through Site 1 and tying the levee into high ground at each end. In addition, seven closure structures would be required: two across the Chenais System tracks and five across existing roadways into the site. These structures would be left open except during periods of flooding to maintain unimpeded access to and through the site. Plan would provide flood protection to the site up to the 100-year flood event. However, the structures in Site 1 on the west side of the unnamed creek would not be protected. This area was left unprotected because it would require that a second levee be constructed on the west bank of the creek and potential additional benefits would not be sufficient to justify the corresponding cost increase (i.e., protection plan for this area was not incrementally justified).</p>							
2. First Cost (1)(2)	\$461,000	\$414,000	\$672,000	\$672,000	\$672,000	\$672,000	\$672,000	\$672,000
Federal	131,000	131,000	166,000	166,000	166,000	166,000	166,000	166,000
Non-Federal	\$592,000 (6)	\$545,000 (6)	\$840,000	\$840,000	\$840,000	\$840,000	\$840,000	\$840,000
Total								
3. Annual Charges (3)								
Federal	\$ 39,200	\$ 35,100	\$ 57,000	\$ 57,000	\$ 57,000	\$ 57,000	\$ 57,000	\$ 57,000
Non-Federal	14,800	13,900	21,300	21,300	21,300	21,300	21,300	21,300
Total	\$ 54,000	\$ 49,000	\$ 78,300	\$ 78,300	\$ 78,300	\$ 78,300	\$ 78,300	\$ 78,300
4. Annual Benefits (4)								
Flood Reduction	\$ 35,700	\$ 35,800	<\$ 35,700 (7)	<\$ 35,700 (7)	<\$ 35,700 (7)	<\$ 35,700 (7)	<\$ 35,700 (7)	<\$ 35,700 (7)
Relocation	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Recreation	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	\$ 35,700	\$ 35,800	<\$ 35,700	<\$ 35,700	<\$ 35,700	<\$ 35,700	<\$ 35,700	<\$ 35,700
5. Benefit-to-Cost Ratio (5)	0.7	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
6. Average Annual Net Benefits (5)	-\$18,300	-\$23,200	<-\$ 42,600	<-\$ 42,600	<-\$ 42,600	<-\$ 42,600	<-\$ 42,600	<-\$ 42,600
7. Significant Environmental Impacts	<p>(a) Beneficial : Reduced flood damages; enhanced property values and tax revenues; protected business and industrial activity; reduction in non-point water pollution sources.</p> <p>(b) Adverse : Obstructed view of creek; disruption of existing vegetation; possible disruption of unknown archaeological sites.</p>							
8. Carry Forward into Detailed Planning	No	No	No	No	No	No	No	No

Table 4 - Assessment, Evaluation, and Comparison of Preliminary Plans (Cont'd)

Item	Site 2 (River Mile 12.9 - See Plate 7)			Alternative Plan 2C (100-Year Floodproofing)			Alternative Plan 2D (50-Year Floodproofing)		
	(100-Year Levee Protection - See Plate 9)	(50-Year Levee Protection - See Plate 9)		(100-Year Floodproofing)			(50-Year Floodproofing)		
1. Plan Description	This plan consists of raising Canal Road in the vicinity of Foadick and Murray Roads and tying the levee back into high ground at each end. In addition, sloped approaches would be provided to maintain vehicular access between the raised Canal Road and Murray and Foadick Roads. Sloped approaches would also be provided at each end to tie the raised portion of Canal Road back into the existing road elevation. Plan would provide flood protection for the Foadick-Murray Road area up to the 100-year flood event. However, the Heintson Road area would not be protected. This area was left unprotected because the benefits for protecting the few structures on Heintson Road would not be sufficient to justify a 25 percent increase in project costs (i.e., protection plan for this area was not incrementally justified).	Similar to Plan 2A except that the levee system would only provide flood protection up to the 50-year flood event. Again, the Heintson Road area would not be protected due to lack of incremental justification.	This plan involves floodproofing the structures within Site 2. Thus, although the area would still be flooded, flood damages up to the 100-year flood event would be reduced significantly. Components of the plan include: 1) relocating utilities above the level of flooding at 38 residences; 2) raising 9 residences such that the first floor is above the level of flooding; and 3) raising 9 residences and relocating their utilities such that they are above the level of flooding. The plan would not, however, provide protection for the commercial structure on Canal Road since this structure, due to its type of construction, cannot be floodproofed.	Similar to Plan 2C except that the level of protection is the 50-year flood event. Components of the plan include: 1) relocating utilities at 42 residences; 2) raising 7 residences; and 3) raising 4 residences and relocating utilities. Again, the commercial structure on Canal Road would not be protected.					
2. First Cost (1)(2)									
Federal	\$1,071,000	\$1,001,000		\$680,000		\$624,000			
Non-Federal	139,000	139,000		123,000		156,000			
Total	\$1,210,000 (6)	\$1,140,000 (6)		\$803,000		\$780,000			
Annual Charges (3)									
Federal	\$ 90,900	\$ 85,000		\$ 57,700		\$ 53,000			
Non-Federal	19,600	19,500		14,700		13,200			
Total	\$ 110,500	\$ 104,500		\$ 72,400		\$ 66,200			
Annual Benefits (4)									
Flood Reduction	\$ 35,300	\$ 29,100		< \$ 35,300 (7)		< \$ 29,100 (7)			
Relocation	N/A	N/A		N/A		N/A			
Recreation	N/A	N/A		N/A		N/A			
Total	\$ 35,300	\$ 29,100		< \$ 35,300		< \$ 29,100			
Benefit-to-Cost Ratio (5)	0.3	0.3		< 0.5		< 0.4			
Average Annual Net Benefits (5)	-\$ 75,000	-\$ 75,400		<-\$ 36,900		<-\$ 37,100			
7. Significant Environmental Impacts									
(a) Beneficial	Reduced flood damages; enhanced property values and tax revenues; protected health and safety; improved view of canal from Canal Road; reduction in nonpoint water pollution sources.	Reduced flood damages; enhanced property values and tax revenues; protected health and safety; improved view of canal from Canal Road; reduction in nonpoint water pollution sources.	Reduced flood damages; enhanced property values and tax revenues; protected health and safety.	Reduced flood damages; enhanced property values and tax revenues; protected health and safety.	Reduced flood damages; enhanced property values and tax revenues; protected health and safety.	Reduced flood damages; enhanced property values and tax revenues; protected health and safety.	Reduced flood damages; enhanced property values and tax revenues; protected health and safety.	Reduced flood damages; enhanced property values and tax revenues; protected health and safety.	Reduced flood damages; enhanced property values and tax revenues; protected health and safety.
(b) Adverse	Obstructed view of canal from Site 2; disruption of existing vegetation; possible disruption of unknown archaeological sites.	Obstructed view of canal from Site 2; disruption of existing vegetation; possible disruption of unknown archaeological sites.	Obstructed view of canal from Site 2; disruption of existing vegetation; possible disruption of unknown archaeological sites.	Obstructed view of canal from Site 2; disruption of existing vegetation; possible disruption of unknown archaeological sites.	Obstructed view of canal from Site 2; disruption of existing vegetation; possible disruption of unknown archaeological sites.	Obstructed view of canal from Site 2; disruption of existing vegetation; possible disruption of unknown archaeological sites.	Obstructed view of canal from Site 2; disruption of existing vegetation; possible disruption of unknown archaeological sites.	Obstructed view of canal from Site 2; disruption of existing vegetation; possible disruption of unknown archaeological sites.	Obstructed view of canal from Site 2; disruption of existing vegetation; possible disruption of unknown archaeological sites.
8. Carry Forward into Detailed Planning	No	No		No		No			

Table 4 - Assessment, Evaluation, and Comparison of Preliminary Plans (Cont'd)

Item	Site 2			Site 3 (River Mile 13.8 - See Plate 7)		
	Alternative Plan 2E (100-Year Relocation - See Plate 10)	Alternative Plan 2F (30-Year Relocation - See Plate 10)	Alternative Plan 3A (100-Year Levee Protection - See Plate 11)	Alternative Plan 3B (50-Year Levee Protection - See Plate 11)		
1. Plan Description	This plan consists of relocating (physically moving) all residential structures within the 100-year floodplain and converting the vacated land to recreational use. Thus, 39 residences would be relocated to sites outside the floodplain. One residence, which cannot be moved because of its type of construction (i.e., slab on grade), would not allow moving equipment to get under the structure), would be demolished. The vacated land would be regraded, seeded, and converted into a 65-acre picnic area. It should be noted, however, that the commercial structure on Canal Road would remain.	This plan is similar to Plan 2E except that only those structures within the 50-year floodplain would be relocated. Thus, 34 residences would be relocated to sites outside the floodplain and one residence would be demolished. The vacated land would be regraded, seeded, and converted into a 60-acre picnic area. Again, the commercial structure on Canal Road would remain.	This plan consists of constructing a levee adjacent to the Cuyahoga River to prevent flood waters from inundating the site. The levee would be tied into high ground at each end. However, a levee cannot be constructed opposite Frank & Frick's because the building is too close to the river. Therefore, a vertical floodwall has been substituted for the levee in this section. In addition, a closure structure would be required across the Chassis System's tracks at the north and south ends of the site. These structures would be closed only when flooding occurs and would be left open the remainder of the time to permit unhindered train movements. Plan would provide flood protection to the site up to the 100-year flood event.	Similar to Plan 3A except that the levee system would only provide flood protection up to the 50-year event.		
2. First Cost (1)(2)						
Federal	\$4,352,000	\$3,988,000	\$646,000	\$611,000		
Non-Federal	4,988,000	4,602,000	89,000	89,000		
Total	\$9,340,000	\$8,590,000	\$735,000 (6)	\$700,000 (6)		
3. Annual Charges (3)						
Federal	\$ 308,900	\$ 281,300	\$ 54,800	\$ 51,900		
Non-Federal	422,800	380,500	12,400	12,400		
Total	\$ 731,700	\$ 661,800	\$ 67,200	\$ 64,300		
4. Annual Benefits (4)						
Flood Reduction	\$ 13,800	\$ 14,300	\$ 65,000	\$ 50,300		
Relocation	422,700	386,900	N/A	N/A		
Recreation	121,500	112,100	\$ 65,000	\$ 50,300		
Total	\$ 558,000	\$ 513,300	\$ 125,000	\$ 100,600		
5. Benefit-to-Cost Ratio (5)	0.8	0.8	1.0	0.8		
6. Average Annual Net Benefits (5)	- \$ 173,700	- \$ 158,500	- \$ 2,200	- \$ 14,000		
7. Significant Environmental Impacts	Reduced flood damages; increased terrestrial habitat; protected health and safety; increased recreational opportunities; reduction in nonpoint water pollution sources.	Reduced flood damages; protected health and safety; increased recreational opportunities; increased terrestrial habitat; reduction in nonpoint water pollution sources.	Reduced flood damages; enhanced property values and tax revenues; protected business and industrial activity; reduction in nonpoint water pollution sources.	Reduced flood damages; enhanced property values and tax revenues; protected business and industrial activity; reduction in nonpoint water pollution sources.		
(a) Beneficial						
(b) Adverse	Disrupted community cohesion; impeded community and regional growth; decreased tax revenues.	Disrupted community cohesion; impeded community and regional growth; decreased tax revenues.	Obstructed view of river from Site 3; disruption of existing vegetation; possible disruption of unknown archaeological sites.	Obstructed view of river from Site 3; disruption of existing vegetation; possible disruption of unknown archaeological sites.		
8. Carry Forward Into Detailed Planning	No	No	Yes	No		

Table 4 - Assessment, Evaluation, and Comparison of Preliminary Plans (Cont'd)

Item	Site 3			Site 4 (River Mile 15.3 - See Plate 7)		
	Alternative Plan 3C (100-Year Floodproofing)	Alternative Plan 3D (50-Year Floodproofing)	Alternative Plan 4A (100-Year Levee Protection - See Plate 12)	Alternative Plan 4B (50-Year Levee Protection - See Plate 12)		
1. Plan Description	This plan involves floodproofing the structures within Site 3. Thus, although the area would still be flooded, flood damages up to the 100-year flood event would be reduced. Components of the plan include sealing and installing temporary or permanent closures on 14 commercial structures to prevent flood waters from entering. All other structures at this site that experience flooding during the 100-year event, due to their type of construction, cannot be floodproofed.	Similar to Plan 3C except that the level of protection is the 50-year flood event. As such, only 13 structures will be sealed and have temporary or permanent closures installed. All other structures in this site that experience flooding during the 50-year event, due to their type of construction, cannot be floodproofed.	This plan consists of raising Canal Road in the vicinity of Francis-Charles-Gleason Road and tying the levee back into high ground at each end. In addition, sloped approaches would be provided to maintain vehicular access between the raised Canal Road and Francis, Charles, and Gleason Roads. Sloped approaches would also be provided at each end to tie the raised portion of Canal Road back into the existing road elevation. Plan would provide flood protection for Site 4 up to the 100-year flood event.	Similar to Plan 4A except that the levee system would only provide flood protection up to the 50-year flood event.		
2. First Cost (1)(2)						
Federal	\$2,288,000	\$1,976,000	\$686,000	\$642,000		
Non-Federal	522,000	494,000	138,000	138,000		
Total	\$2,810,000	\$2,470,000	\$824,000 (6)	\$780,000 (6)		
3. Annual Charges (3)						
Federal	\$ 194,300	\$ 167,800	\$ 58,300	\$ 54,600		
Non-Federal	73,300	62,900	16,400	16,400		
Total	\$ 267,600	\$ 230,700	\$ 74,700	\$ 71,000		
4. Annual Benefits (4)						
Flood Reduction	< \$ 65,000 (7)	< \$ 50,300 (7)	\$ 73,100	\$ 66,000		
Relocation	N/A	N/A	N/A	N/A		
Recreation	N/A	N/A	N/A	N/A		
Total	< \$ 85,000	< \$ 50,300	\$ 73,100	\$ 66,000		
5. Benefit-to-Cost Ratio (5)	< 0.2	< 0.2	1.0	0.9		
6. Average Annual Net Benefits (5)	< \$ 202,800	< \$ 180,400	- \$ 1,600	- \$ 5,000		
7. Significant Environmental Impacts (a) Beneficial	Reduced flood damages; enhanced property values and tax revenues; protected business and industrial activity.	Reduced flood damages; enhanced property values and tax revenues; protected business and industrial activity.	Reduced flood damages; enhanced property values and tax revenues; protected health and safety; improved view of canal from Canal Road; reduction in nonpoint water pollution sources; protected commercial activity.	Reduced flood damages; enhanced property values and tax revenues; protected health and safety; improved view of canal from Canal Road; reduction in nonpoint water pollution sources; protected commercial activity.		
(b) Adverse	Occupants could become isolated during floods; structural modifications may detract from the existing appearance of the buildings.	Occupants could become isolated during floods; structural modifications may detract from the existing appearance of the buildings.	Obstructed view of canal from Site 4; disruption of existing vegetation; possible disruption of unknown archaeological sites.	Obstructed view of canal from Site 4; disruption of existing vegetation; possible disruption of unknown archaeological sites.		
8. Carry Forward Into Detailed Planning	No	No	Yes	No		

Table 4 - Assessment, Evaluation, and Comparison of Preliminary Plans (Cont'd)

Item	Site 4			
	Alternative Plan 4C (100-Year Levee Protection with Channelization and Gravel Bar and Bridge Removal - See Plate 13)	Alternative Plan 4D (50-Year Levee Protection with Channelization and Gravel Bar and Bridge Removal - See Plate 13)	Alternative Plan 4E (100-Year Levee Protection with Bridge Removal - See Plate 14)	Alternative Plan 4F (50-Year Levee Protection with Bridge Removal - See Plate 14)
1. Plan Description	Similar to Plan 4A. In addition, the gravel bar in the river just downstream of the Stone Road bridge and the Stone Road bridge and its east abutment would be removed. Further, the river would be straightened just upstream of the Stone Road bridge to eliminate the existing oxbow. These items would lower the water surface elevation of the river during flooding producing a corresponding decrease in the required height of the levee of about 3.5 feet. The tie back portions of the levee system would also be shortened. Plan would provide flood protection for Site 4 up to the 100-year flood event.	Similar to Plan 4C except that the levee system would only provide flood protection up to the 50-year flood event.	Similar to Plan 4A. In addition, the Stone Road bridge and its east abutment would be removed. The river would also be widened at this location to a width of about 250 feet by cutting back the east bank. These two items would lower the water surface elevation of the river during flooding producing a corresponding decrease in the required height of the levee of about 2 feet. The tie back portions of the levee system would also be shortened. Plan would provide flood protection for Site 4 up to the 100-year flood event.	Similar to Plan 4E except that the levee system would only provide flood protection up to the 50-year flood event.
2. First Cost (1)(2)				
Federal	\$1,517,000	\$1,477,000	\$862,000	\$767,000
Non-Federal	233,000	233,000	124,000	124,000
Total	\$1,750,000 (6)	\$1,710,000 (6)	\$986,000 (6)	\$891,000 (6)
3. Annual Charges (3)				
Federal	\$ 128,800	\$ 125,400	\$ 73,200	\$ 65,100
Non-Federal	31,300	31,300	17,300	16,300
Total	\$ 160,100	\$ 156,700	\$ 90,500	\$ 81,400
4. Annual Benefits (4)				
Flood Reduction	\$ 73,100	\$ 66,000	\$ 73,100	\$ 66,000
Relocation	N/A	N/A	N/A	N/A
Recreation	N/A	N/A	N/A	N/A
Total	\$ 73,100	\$ 66,000	\$ 73,100	\$ 66,000
5. Benefit-to-Cost Ratio (5)	0.5	0.4	0.8	0.8
6. Average Annual Net Benefits (5)	-\$ 87,000	-\$ 90,700	-\$ 17,400	-\$ 15,400
7. Significant Environmental Impacts	Reduced flood damages; enhanced property values and tax revenues; protected health and safety; protected commercial activity; improved view of canal from Canal Road; reduction in nonpoint water pollution sources; increased stream bottom habitat at the gravel bar.	Reduced flood damages; enhanced property values and tax revenues; protected health and safety; protected business activity; improved view of canal from Canal Road; reduction in nonpoint water pollution sources; increased stream bottom habitat at the gravel bar.	Reduced flood damages; enhanced property values and tax revenues; protected health and safety; improved view of canal from Canal Road; reduction in nonpoint water pollution sources; protected commercial activity.	Reduced flood damages; enhanced property values and tax revenues; protected health and safety; improved view of canal from Canal Road; reduction in nonpoint water pollution sources; protected business activity.
(a) Beneficial				
(b) Adverse	Obstructed view of canal from Site 4; disruption of existing vegetation; possible disruption of unknown archaeological sites; short-term disruption of stream bottom and streambank habitat; decreased streambank and stream bottom habitat at the oxbow.	Obstructed view of canal from Site 4; disruption of existing vegetation; possible disruption of unknown archaeological sites; short-term disruption of stream bottom and streambank habitat; decreased streambank and stream bottom habitat at the oxbow.	Obstructed view of canal from Site 4; disruption of existing vegetation; possible disruption of unknown archaeological sites; short-term disruption of streambank habitat.	Obstructed view of canal from Site 4; disruption of existing vegetation; possible disruption of unknown archaeological sites; short-term disruption of streambank habitat.
8. Carry Forward into Detailed Planning	No	No	No	No

Table 4 - Assessment, Evaluation, and Comparison of Preliminary Plans (Cont'd)

Item	Site 4			Alternative Plan 4J (100-Year Relocation - See Plate 16)
	Alternative Plan 4C (Remove Stone Road Bridge - See Plate 15)	Alternative Plan 4H (100-Year Floodproofing)	Alternative Plan 4I (50-Year Floodproofing)	
1. Plan Description	<p>Plan 4C consists of removing the Stone Road Bridge and its east abutment. In addition, the river would be widened at this location to a width of about 250 feet by cutting back the east bank. These two items would lower the water surface elevation of the river during flooding and would provide flood protection for Site 4 up to the 2-year flood event.</p>	<p>This plan involves floodproofing the structures within Site 4. Thus, although the area would still be flooded, flood damages up to the 100-year flood event would be reduced significantly. Components of the plan include: 1) relocating utilities above the level of flooding at 13 residences; 2) raising 7 residences such that the first floor is above the level of flooding; 3) raising 23 residences and relocating their utilities such that they are above the level of flooding; and 4) sealing and installing temporary or permanent closures on the two commercial structures to prevent floodwaters from entering.</p>	<p>Similar to Plan 4H except that the level of protection is the 50-year flood event. Components of the plan include: 1) relocating utilities at 20 residences; 2) raising one residence; 3) raising 14 residences and relocating utilities; and 4) sealing and installing temporary or permanent closures at the two commercial sites.</p>	<p>This plan consists of relocating (physically moving) all residential structures within the 100-year floodplain and converting the vacated land to recreational use. Thus, 44 residences would be relocated to sites outside the floodplain. One residence, which cannot be moved because of its type of construction (i.e., slab construction which would not allow moving equipment to get under the structure), would be demolished. The two commercial structures would be floodproofed. The vacated land (30 acres) would be incorporated into the CYNRA. Based on preliminary discussions, the National Park Service intends to restore the area to natural conditions with several small picnic areas.</p>
2. First Cost (1)(2)	\$337,000	\$ 948,000	\$ 800,000	\$3,510,000
Federal	4,000	237,000	200,000	3,580,000
Non-Federal	\$361,000	\$1,185,000	\$1,000,000	\$7,090,000
3. Annual Charges (3)				
Federal	\$ 30,300	\$ 80,500	\$ 67,900	\$ 252,500
Non-Federal	3,300	23,100	20,000	298,000
Total	\$ 33,600	\$ 103,600	\$ 87,900	\$ 550,500
4. Annual Benefits (4)				
Flood Reduction	\$ 51,000	<\$ 73,100 (7)	<\$ 66,000 (7)	\$ 63,100
Relocation	N/A	N/A	N/A	371,200
Recreation	N/A	N/A	N/A	59,700
Total	\$ 51,000	<\$ 73,100	<\$ 66,000	\$ 494,000
5. Benefit-to-Cost Ratio (5)	1.5	<0.7	<0.8	0.9
6. Average Annual Net Benefits (5)	\$ 17,400	<\$ 30,500	<\$ 21,900	-\$ 56,500
7. Significant Environmental Impacts:				
(a) Beneficial	Reduced flood damages; enhanced property values and tax revenues; protected health and safety; reduction in nonpoint water pollution sources; protected business activity.	Reduced flood damages; enhanced property values and tax revenues; protected health and safety; protected business activity.	Reduced flood damages; enhanced property values and tax revenues; protected health and safety; protected business activity.	Reduced flood damages; protected health and safety; increased terrestrial habitat; increased recreational opportunities; protected business activity; reduction in nonpoint water pollution sources.
(b) Adverse	Short-term disruption of stream bank habitat.	Occupants could become isolated during floods; structural modifications may detract from the existing appearance of the residences.	Occupants could become isolated during floods; structural modifications may detract from the existing appearance of the residences.	Disrupted community cohesion; impeded community and regional growth; decreased tax revenues.
8. Carry Forward Into Detailed Planning	Yes	No	No	No

Table 4 - Assessment, Evaluation, and Comparison of Preliminary Plans (Cont'd)

	Site 4	
	Alternative Plan 4K	Alternative Plan 5
Item	(50-Year Relocation - See Plate 17)	("No-Action")
1. Plan Description	This plan is similar to Plan 4J except that only those structures within the 50-year floodplain would be relocated. Thus, 35 residences would be relocated to sites outside the floodplain and one residence would be demolished. The two commercial structures would be floodproofed. The vacated land (25 acres) would be incorporated into the CVNRA. Based on preliminary discussions, the National Park Service intends to restore the area to natural conditions with several small picnic areas.	The "No-Action" alternative represents the base condition for evaluation of the 25 preliminary plans previously discussed. Under this plan, flooding of Sites 1-4 in the Valley View/Independence area would continue as before.
2. First Cost (1)(2)		
Federal	\$2,915,000	0
Non-Federal	2,925,000	0
Total	\$5,840,000	0
3. Annual Charges (3)		
Federal	\$ 246,900	0
Non-Federal	208,100	0
Total	\$ 455,000	0
4. Annual Benefits (4)		
Flood Reduction	\$ 62,800	0
Relocation	292,000	0
Recreation	49,800	0
Total	\$ 404,600	0
5. Benefit-to-Cost Ratio (5)	0.9	-
6. Average Annual Net Benefits (5)	-\$ 50,400	-
7. Significant Environmental Impacts		
(a) Beneficial	Reduced flood damages; protected health and safety; increased terrestrial habitat; increased recreational opportunities; protected business activity; reduction in non-point water pollution sources.	None
(b) Adverse	Disrupted community cohesion; impeded community and regional growth; decreased tax revenues.	Continued flood damages; transport of sediments and other pollutants to the Cuyahoga River by flood waters; endangered health and safety; disrupted business and industrial activity; depressed property values and tax revenues.
8. Carry Forward Into Detailed Planning	No	Yes

(1) Based on October 1983 price levels.

(2) Does not include cost for mitigation of adverse environmental impacts that may be required.

(3) Based on October 1983 price levels, 8-1/8 percent interest rate, and 50-year economic life. Includes interest during construction.

(4) Based on October 1983 price levels, 8-1/8 percent interest rate, and 50-year economic life.

(5) Based on October 1983 price levels, 8-1/8 percent interest rate, and 50-year economic life.

(6) Does not include cost to accommodate internal drainage or overland flow from outside the area.

(7) Since this nonstructural plan would not provide flood protection for all structures within the site, annual flood reduction benefits would be less than those for the corresponding levee plan. Further, since the plan would not be feasible (i.e., B/C less than 1.0) even if all the annual flood reduction benefits for the corresponding levee plan were realized, a detailed benefit analysis was not conducted for this plan.

19. DEVELOPMENT OF DETAILED ALTERNATIVE PLANS

a. General.

As previously discussed, three structural plans, in addition to the "No-Action" plan (Plan 5), were carried forward into the detailed planning phase of the study. These plans were: Plan 3A (100-Year Levee Protection at Site 3); Plan 4A (100-Year Levee Protection at Site 4); and Plan 4G (Removing the Stone Road Bridge). Emphasis in this phase was placed on refining the designs, quantities and cost estimates for these plans. Further, additional field information was obtained to: refine water surface elevations associated with the river under both with and without project conditions for various flood events; and to update the real estate appraisal for structures within Site 4.

During the detailed planning phase, several additional alternatives were also formulated. The first two additional alternatives (Plans 4A(I) and 4A(II)), involved relocating the proposed levee at Site 4 upland of the CVNRA lands in this area. This was required because the National Park Service opposed Plan 4A, as originally formulated, due to its incompatibility with the Service's stated goals for the area. These goals center around enjoyment of the historic Ohio and Erie Canal. Therefore Plan 4A was dropped from further consideration at the beginning of the detailed planning phase and Plans 4A(I) and 4A(II) were considered instead.

The second set of plans added during the detailed planning phase involved various modifications of Plan 4G. These modifications included just removing the abandoned Stone Road bridge and its east abutment up to and including channelization of the river in the immediate area. However, because the refined water surface elevation data developed during the detailed planning phase indicated that widening the channel to 250 feet in the immediate vicinity of the Stone Road bridge would have only minimal effect in reducing flood damages at Site 4, Plan 4G was dropped from further consideration and Plans 4G(I) through 4G(IX) were considered instead.

b. Assessment, Evaluation and Comparison of Detailed Plans.

Table 5, following, provides a brief description of the 12 plans considered during the detailed planning phase to reduce flood damages at Sites 3 and 4 in the Valley View/Independence area along with their estimated costs. The table also compares the economic impacts of these 12 plans. The basis of comparison is the "No-Action" (do-nothing) plan. (Note: As previously discussed, Plans 4A and 4G were dropped from further consideration early in the detailed planning phase and are not discussed in Table 5.)

c. Rationale for Tentatively Recommended Plan.

The primary criteria used in selecting a recommended plan is economic efficiency. As such, to be eligible for consideration, an alternative must, as a minimum, have a benefit-to-cost ratio greater than 1.0. However, as indicated in Table 5, no plan has a benefit-to-cost ratio greater than 1.0. Therefore, the Tentatively Recommended Plan is the "No-Action" (do-nothing) plan.

Table 5 - Assessment, Evaluation, and Comparison of Detailed Plans

Item	Plan 3A (Modified) (see Plate 18)	Plan 4A(1) (see Plate 19)	Plan 4A(11) (see Plate 20)	Plan 4G(1) (see Plate 21)
1. Plan Description				
: This plan consists of constructing a levee	: This plan consists of constructing a levee	: This plan consists of constructing a levee	: Similar to Plan 4A(1). However, to elim-	: Plan 4G(1) consists solely of removing the
: adjacent to the Cuyahoga River to prevent	: adjacent to Canal Road to prevent flood	: parallel to Canal Road to prevent flood	: nate the necessity of removing four homes,	: abandoned Stone Road bridge and its east
: flood waters from entering the site. The	: waters from inundating the site. The levee	: a vertical flood wall has been substituted	: a vertical flood wall has been substituted	: shuntment. However, it would have only
: levee would be tied into high ground at	: would be tied into high ground at each end.	: for the levee between Charles Drive and	: Stone Road. In addition, because of the	: minimal effect in lowering the water surface
: each end. However, a levee cannot be com-	: homes, to make room for the levee, four	: Stone Road. In addition, because of the	: floodwall, closure structures would be	: elevation of the river during flooding and
: structed opposite Frank & Frick's because	: homes would have to be removed. In addition,	: sloped approaches would be provided to	: required across Charles and Francis Drives	: would reduce average annual flood damages
: the building is too close to the river.	: maintain vehicular access between Canal Road	: and Stone Road. Those structures would be	: closed only when flooding occurs and would	: by less than 1%.
: Therefore, a vertical floodwall has been	: substituted for the levee in this section.	: A sloped approach would also be provided on	: be left open the remainder of the time to	
: In addition, 3 closure structures would be	: tracks and one across Rockside Road. These	: road back into the existing road elevation.	: site. Plan would provide flood protection	
: required: two across Rockside Road. These	: structures would be closed only when flood-	: ing occurs and would be left open the	: remainder of the time to permit unhindered	
: structures would be closed only when flood-	: remainder of the time to permit unhindered	: access to and through the site. Further,	: to accommodate internal drainage, a 3 acre	
: ing structures would be closed only when flood-	: ponding area would be provided. Plan would	: provide flood protection to the site up to	: the 100-year flood event.	
: the 100-year flood event.				
2. First Cost (1)	\$806,000	\$821,000 (4)	\$906,000 (4)	\$118,000
Federal	719,000	374,000 (4)	54,000 (4)	0
Non-Federal	\$1,325,000	\$1,195,000 (4)	\$960,000 (4)	\$118,000
Total				
3. Annual Charges (2)				
Federal	\$ 72,200	\$ 73,500 (5)	\$ 81,100 (5)	\$ 10,500
Non-Federal	69,200	33,400 (5)	4,700 (5)	0
Total	\$141,400	\$106,900 (5)	\$ 85,800 (5)	\$ 10,500
4. Average Annual Flood Reduction Benefits (3)	\$ 66,200	<\$50,100 (6)	<\$ 50,100 (6)	\$ 100
5. Benefit-to-Cost Ratio (3)	0.47	<0.47 (7)	<0.58 (7)	0.01
6. Average Annual Net Benefits (3)	-\$75,200	>-\$56,800 (7)	>-\$ 35,700 (7)	-\$ 10,400
7. Eligible for Consideration as the Selected Plan	NO	NO	NO	NO

Table 5 - Assessment, Evaluation, and Comparison of Detailed Plans (Cont'd)

Item	Plan 4G(II) (see Plate 22)	Plan 4G(III) (see Plate 23)	Plan 4G(IV) (see Plate 24)	Plan 4G(V) (see Plate 24)
1. Plan Description	This plan consists of removing the abandoned Stone Road bridge and its east abutment; removing the shoal under the bridge; and excavating a floodway to elevation 604 along the right bank of the river. These features would reduce the water surface elevation of the river during flooding which, in turn, would reduce average annual flood damages by about 44%.	Similar to Plan 4G(II). In addition, the river would be widened just upstream of the bridge to a width of about 250 feet by cutting back the left bank. These features would reduce the water surface elevation of the river during flooding which, in turn, would reduce average annual flood damages by about 81%.	Plan 4G(IV) consists of removing the abandoned Stone Road bridge and its east abutment; removing the shoal under the bridge; widening the river just upstream of the bridge to a width of about 150 feet by cutting back the right bank; and excavating a floodway to elevation 604 along the right bank of the river. These features would reduce the water surface elevation of the river during flooding which, in turn, would reduce average annual flood damages by about 77%.	Similar to Plan 4G(IV) except that the floodway would be excavated to an elevation of 605. Would reduce average annual flood damages by about 76%.
2. First Cost (1)				
Federal	\$298,000	\$735,000	\$440,000	\$436,000
Non-Federal	26,000	74,000	26,000	26,000
Total	\$ 324,000	\$ 809,000	\$466,000	\$462,000
3. Annual Charges (2)				
Federal	\$ 26,400	\$ 65,100	\$ 39,000	\$ 38,600
Non-Federal	4,300	8,500	4,300	4,300
Total	\$ 30,700	\$ 73,600	\$ 43,300	\$ 42,900
4. Average Annual Flood Reduction Benefits (3)	\$ 22,200	\$ 40,500	\$ 38,500	\$38,200
5. Benefit-to-Cost Ratio (3)	0.72	0.55	0.89	0.89
6. Average Annual Net Benefits (3)	-\$8,500	-\$33,100	-\$ 4,800	-\$ 4,700
7. Eligible for Consideration as the Selected Plan	NO	NO	NO	NO

Table 5 - Assessment, Evaluation, and Comparison of Detailed Plans (Cont'd)

Item	Plan 4C(VI) (see Plate 24)	Plan 4C(VII) (see Plate 25)	Plan 4C(VIII) (see Plate 26)	Plan 4C(IX) (see Plate 27)
1. Plan Description	Similar to Plan 4C(IV) except that the floodway would be excavated to an elevation of 606. Would reduce average annual flood damages by about 75%.	This plan consists of removing the abandoned Stone bridge and its east abutment; removing the shoal under the bridge; and widening the river at this location to a width of 150 feet by cutting back the right bank. These features would reduce the water surface elevation of the river during flooding which, in turn, would reduce average annual flood damages by about 75%.	Similar to Plan 4C(VII) except that, in order to reduce costs, the Stone Road bridge and its east abutment would be left in place. The east abutment would be stabilized, however, by encasing the abutment in cement grout. Plan would still reduce average annual flood damages by about 75%.	Plan 4C(IX) consists of relocating the river channel in the vicinity of the Stone Road bridge approximately 150 feet to the east. Minimum bottom width of the relocated channel would be 150 feet. Excavated material from the relocated channel would be used to fill in the abandoned segment of the river. These features would reduce the water surface elevation of the river during flooding which, in turn, would reduce average annual flood damages by about 75%.
2. First Cost (1)				
Federal	\$434,000	\$430,000	\$403,000	\$592,000
Non-Federal	26,000	13,000	13,000	20,000
Total	\$460,000	\$443,000	\$416,000	\$612,000
3. Annual Charges (2)				
Federal	\$38,500	\$38,100	\$35,700	\$52,400
Non-Federal	4,300	3,100	4,100	3,800
Total	\$42,800	\$41,200	\$39,800	\$56,200
4. Average Annual Flood Reduction Benefits (3)	\$38,000	\$37,900	\$37,900	\$37,900
5. Benefit-to-Cost Ratio (3)	0.89	0.92	0.95	0.67
6. Average Annual Net Benefits (3)	-\$4,800	-\$3,300	-\$1,900	-\$18,300
7. Eligible for Consideration as the Selected Plan	NO	NO	NO	NO

Table 5 - Assessment, Evaluation, and Comparison of Detailed Plans (Cont'd)

Item	:	Plan 5 "No-Action"
1. Plan Description	:	The "No-Action" alternative represents the base condition for evaluation of the 12 plans previously discussed. Under this plan, flooding of Sites 1-4 in the Valley View/Independence area would continue as before.
2. First Cost (1)	:	
Federal	:	0
Non-Federal	:	0
Total	:	0
3. Annual Charges (2)	:	
Federal	:	0
Non-Federal	:	0
Total	:	0
4. Average Annual Flood Reduction Benefits (3)	:	0
5. Benefit-to-Cost Ratio (3)	:	-
6. Average Annual Net Benefits (3)	:	-
7. Eligible for Consideration as the Selected Plan	:	YES

- (1) Unless otherwise noted, costs are based on July 1985 price levels. Further, estimates do not include costs for mitigation of adverse environmental impacts that may or may not be required.
- (2) Unless otherwise noted, annual charges are based on July 1985 price levels, 8-5/8% interest rate and 50-year economic life. Includes interest during construction.
- (3) Unless otherwise noted, based on July 1985 price levels, 8-5/8% interest rate and 50-year economic life.
- (4) Based on November 1984 price levels. Does not include costs for mitigation of adverse environmental impacts that may or may not be required nor cost to accommodate internal drainage or overland flow from outside the area.
- (5) Based on November 1984 price levels, 8-5/8% interest rate and 50-year economic life. Includes interest during construction.
- (6) Average annual flood reduction benefits not estimated for this plan. However, even if all flood damages at the site (\$50,100/year) were eliminated, the plan would still not be economically justified.
- (7) Costs are based on November 1984 price levels, 8-5/8% interest rate and 50-year economic life. Benefits are based on July 1985 price levels, 8-5/8% interest rate and 50-year economic life.

SECTION V

CONCLUSIONS

The primary purpose of this section is to provide a summary of the significant conclusions reached during this feasibility study.

20. CONCLUSIONS

The Cuyahoga River is about 100 miles long and drains some 810 square miles of northeastern Ohio as shown on Figure 1. The river begins at an elevation of about 1,300 feet, several miles northeast of Burton in Geauga County, and flows in a southerly direction towards Hiram Rapids, where the direction changes southwesterly through Mantua, Kent, and Cuyahoga Falls, to the confluence with the Little Cuyahoga River at Akron. From Akron, the river flows north to Cleveland, to an elevation of about 570 feet. The lower 5.8 miles are part of an existing Federal navigation project for Cleveland Harbor, one of Lake Erie's major ports.

The main tributaries of the Cuyahoga River are Big, Mill, Brandywine, Tinkers, Yellow, and Chippawa Creeks; Mud Brook, Furnace Run, Little Cuyahoga River, Congress Lake outlet (Breakneck Creek), and West Branch Cuyahoga River. The overall basin consists of rolling hills and many natural small lakes and ponds. A relatively distinct escarpment near Cleveland divides the basin between an upland plateau and the narrow lake plain.

The primary water resources need for which a solution is sought under this authority is to reduce flood damages at four specific sites in the Valley View/Independence area (Sites 1-4). As possible solutions to addressing this need, 25 preliminary alternatives and 12 additional detailed alternatives, in addition to the "No-Action" option, were formulated and assessed. These alternatives fell into four broad categories: levee protection, minor channelization, floodproofing, and floodplain relocation with conversion of the vacated land to recreational use. However, no plan was economically justified (i.e., benefit-to-cost ratios for all plans were less than 1.0), and therefore the Tentative Recommended Plan is the "No-Action" (do-nothing) plan.

SECTION VI

RECOMMENDATION

21. TENTATIVE RECOMMENDATION

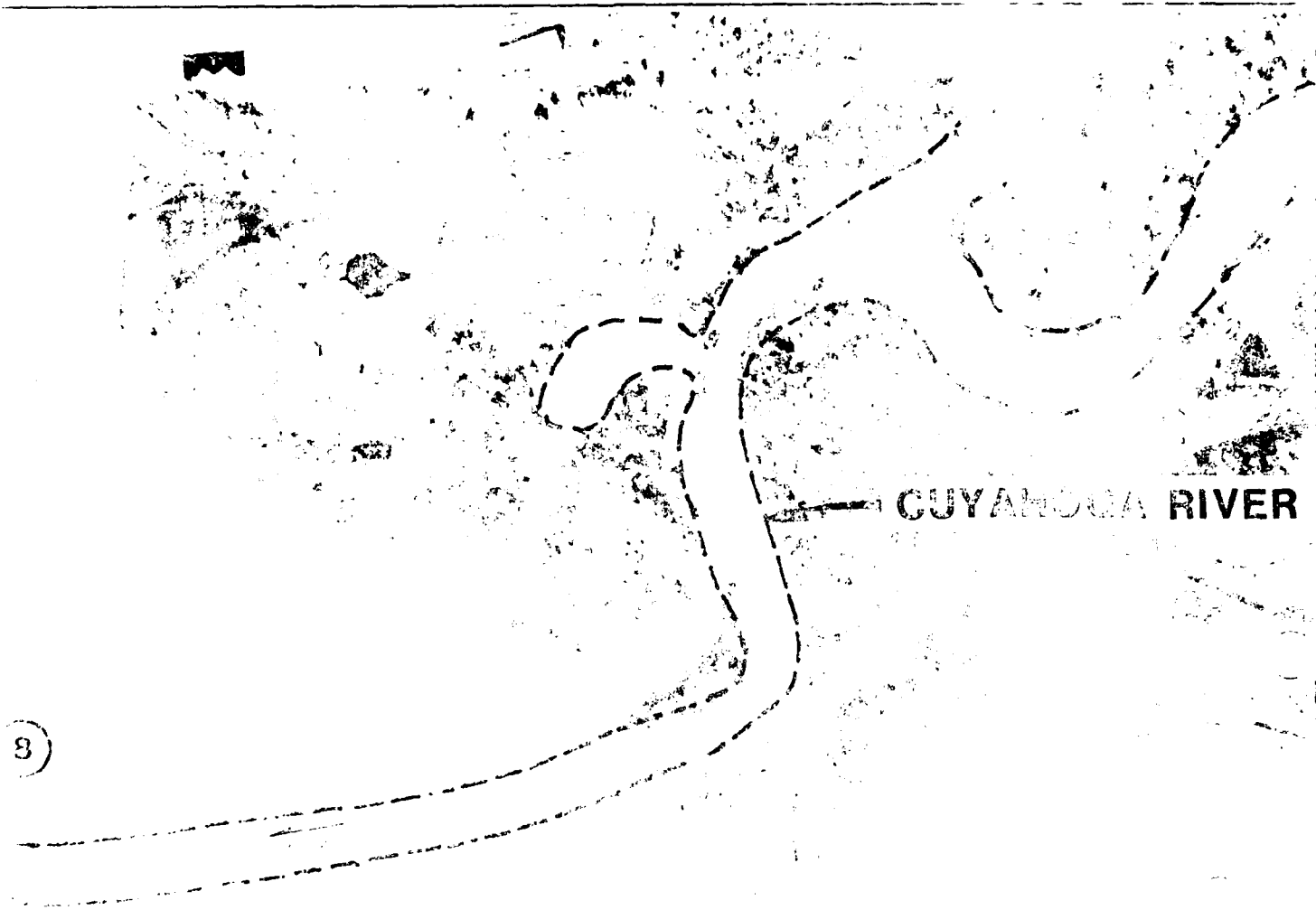
After consideration of environmental, social and economic effects as well as engineering feasibility, I have concluded that the best overall plan for reducing flood damages in the Valley View/Independence area (Sites 1-4) is the "No-Action" (do-nothing) plan. I, therefore, recommend that this study be terminated. In addition, as this is the final report to be prepared under the Cuyahoga River Restoration Study study authority, I further recommend that the study authority be terminated.

DANIEL R. CLARK
Colonel, Corps of Engineers
District Commander

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BRADLEY ROAD

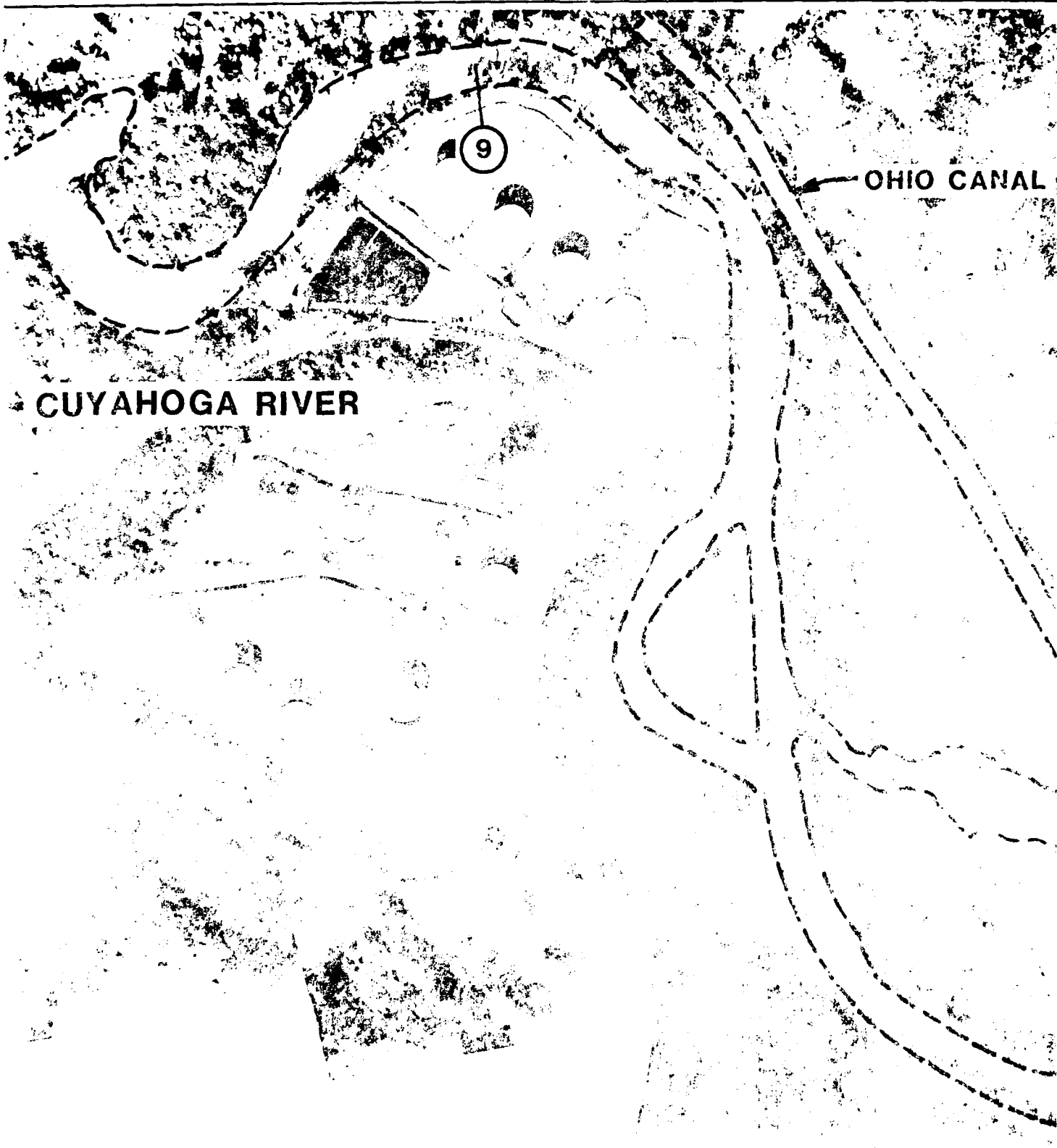
CUYANOGA RIVER

SCALE OF FEET

400 0 400

LEG

8



CUYAHOGA RIVER

OHIO CANAL

SCALE FEET



LEGEND



DISTANCE FROM MOUTH IN MILES



EXTENT OF FLOODING FOR THE SEPTEMBER 14, 1949
FLOOD (APPROXIMATELY 40 YEAR EVENT)

CUYAHOGA RIVER
RESTORATION

FLOOD AT
MILES 7.4

U.S. ARMY ENGINEER CORPS
PORTLAND, ORE.



OHIO CANAL

JOIN WITH A-A

FROM MOUTH IN MILES

LOADING FOR THE SEPTEMBER 4, 1979
PROXIMATELY 40 YEAR EVENT

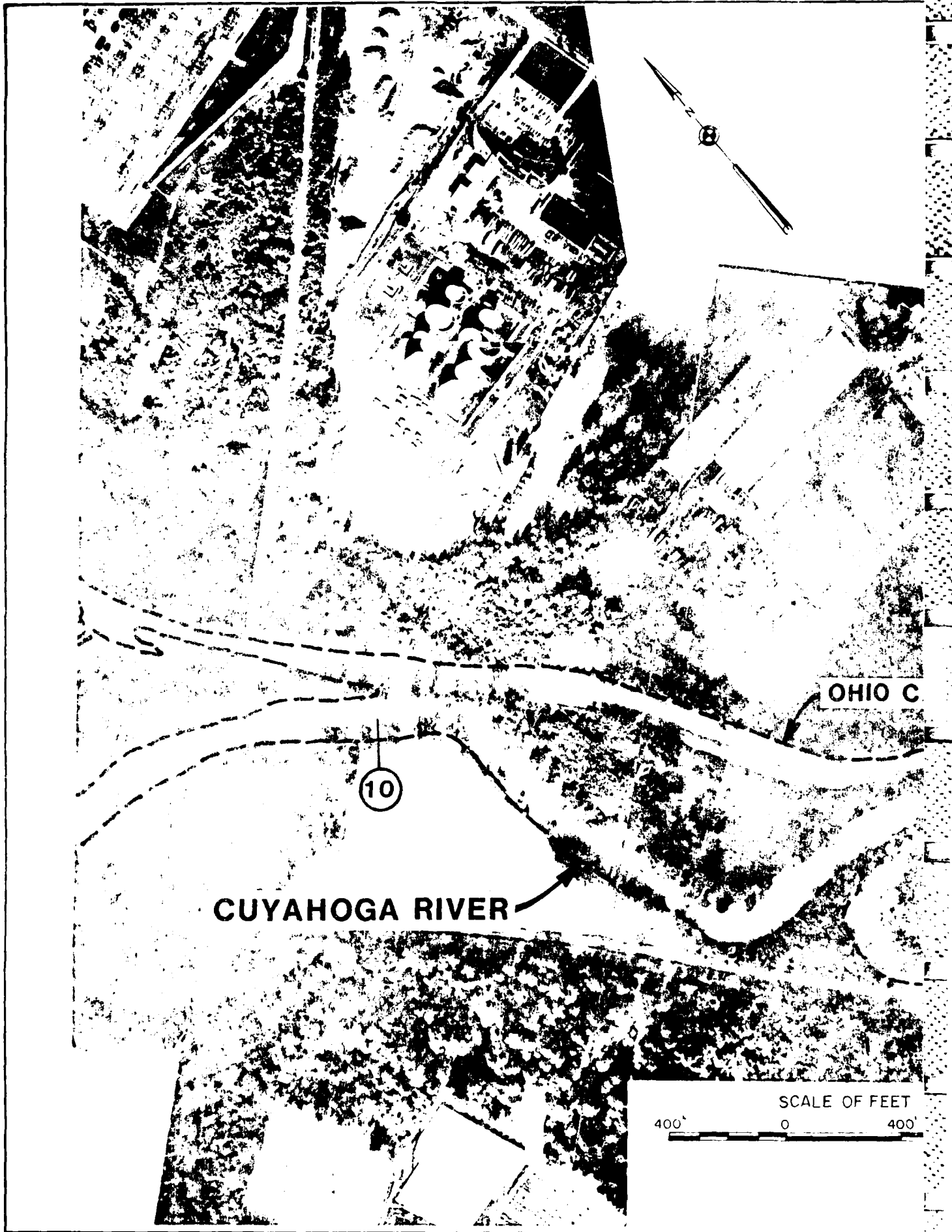
CUYAHOGA RIVER, OHIO
RESTORATION STUDY

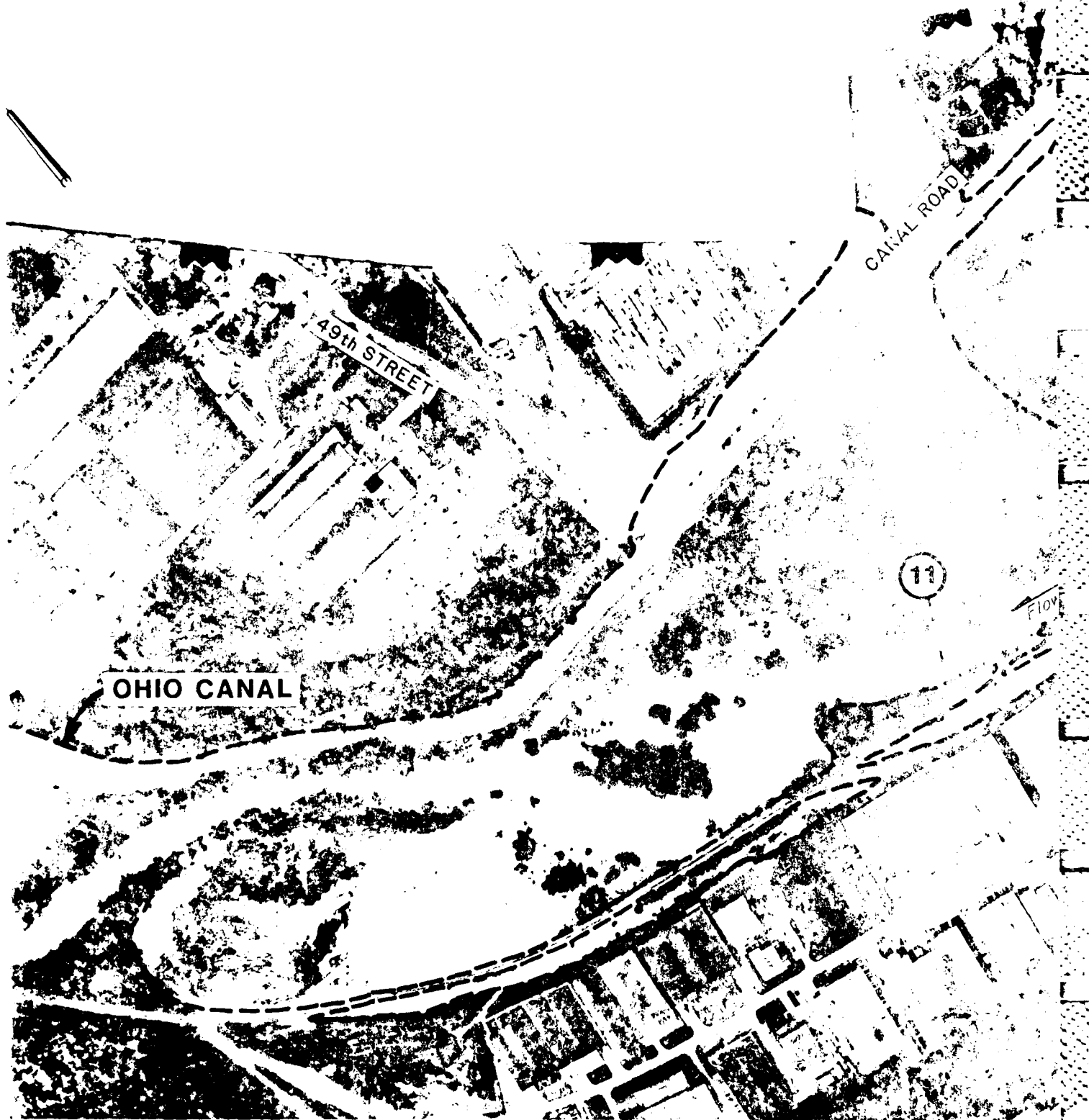
FLOOD AREAS
MILES 7.4 TO 9.8

U.S. ARMY ENGINEER DISTRICT
DECEMBER 1985

BUFFALO

PLATE I





SCALE OF FEET



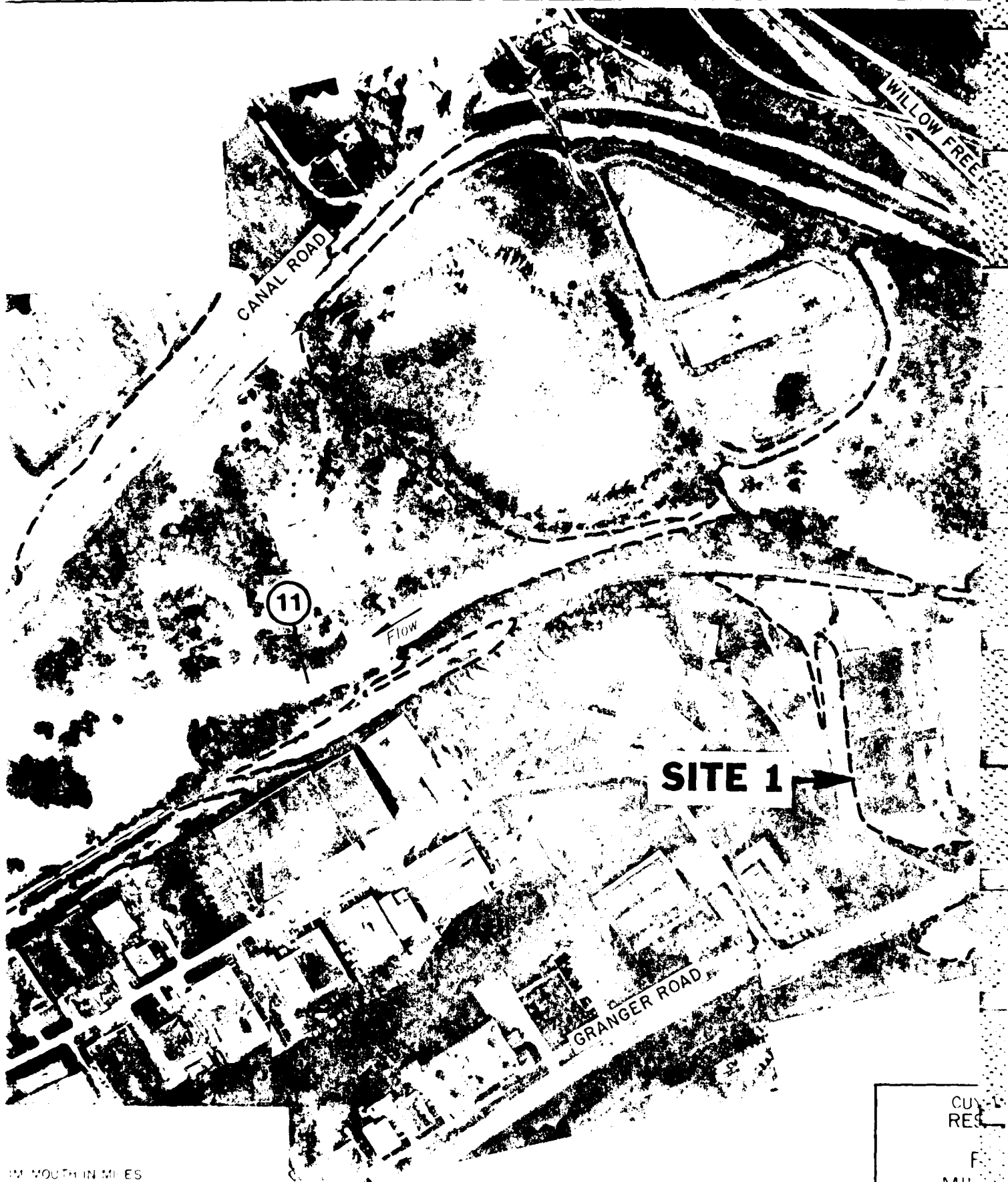
LEGEND



DISTANCE FROM MOUTH IN MILES



LIMIT OF FLOODING FOR THE SEPTEMBER 14, 1979
FLOOD (APPROXIMATELY 40 YEAR EVENT)



100-YEAR FLOOD IN MILES

100-YEAR FLOOD FOR THE SEPTEMBER 14, 1979
(APPROXIMATELY 100-YEAR EVENT)

CIVIL
RES
F
MIL
U.S. ARMY



JOIN WITH B-B,

CUYAHOGA RIVER, OHIO
RESTORATION STUDY

FLOOD AREAS
MILES 9.8 TO 11.7

U.S. ARMY ENGINEER DISTRICT
DECEMBER 1985

BUFFALO

PLATE 2

9

MILL CREEK

OHIO C

CUYAHOGA RIVER

12

GRANGER ROAD

JOIN WITH B-B,

WILLOW FREEDAY

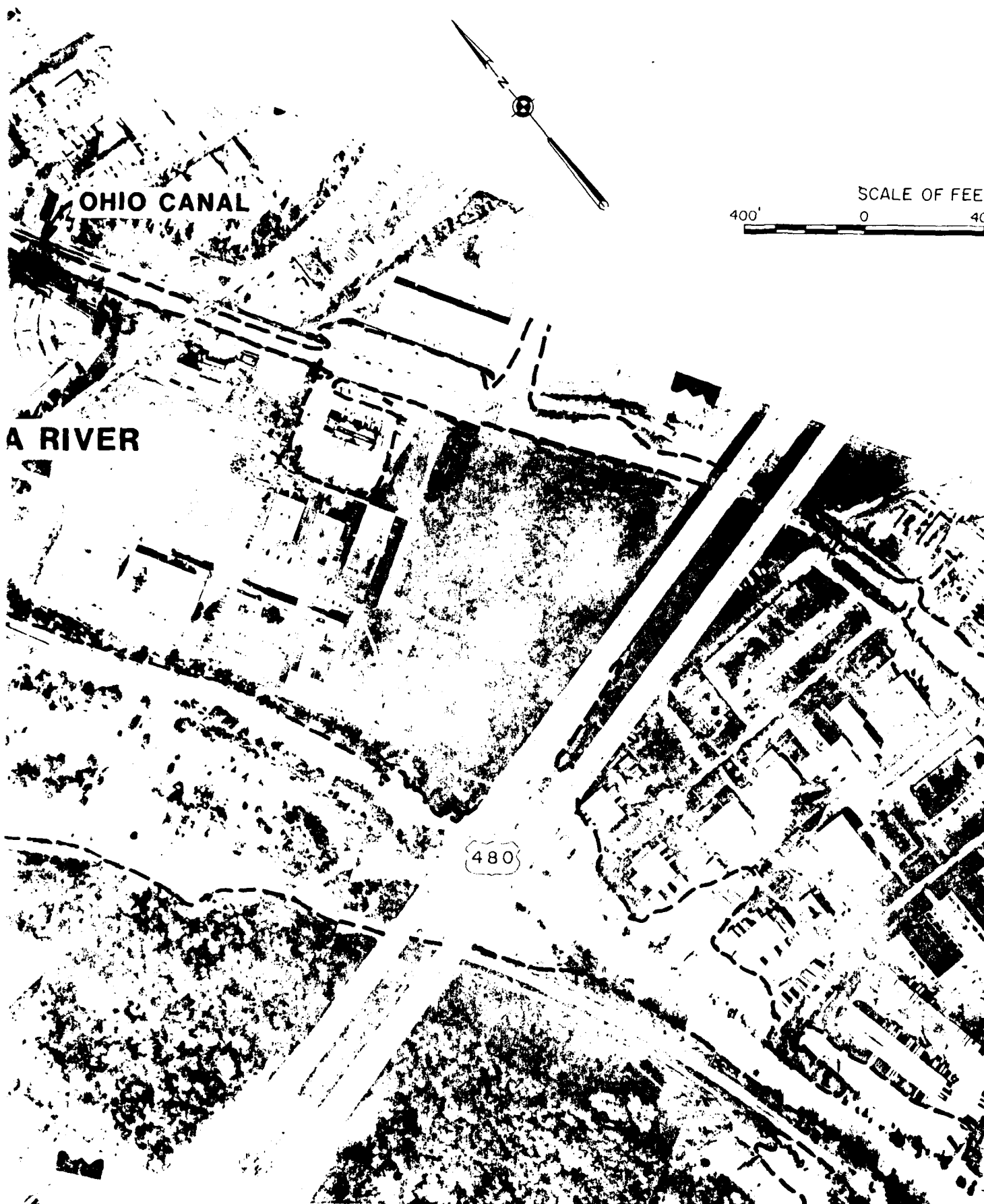
OHIO CANAL

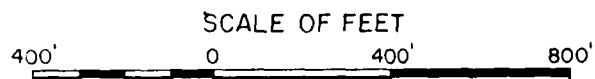
SCALE OF FEET

400' 0 400'

A RIVER

480





LEGEND:



DISTANCE FROM MOUTH IN MILES



LIMIT OF FLOODING FOR THE SEPTEMBER 14, 1979
FLOOD (APPROXIMATELY 40 YEAR EVENT)

VALLEY VIEW

FOSDICK ROAD

MURRAY ROAD

SITE 2

JOIN WITH C-C,

CUYAHOGA RIVER
RESTORATION

FLOOD AREA
MILES 11.7

U.S. ARMY ENGINEER DISTRICT
DECEMBER

LEGEND

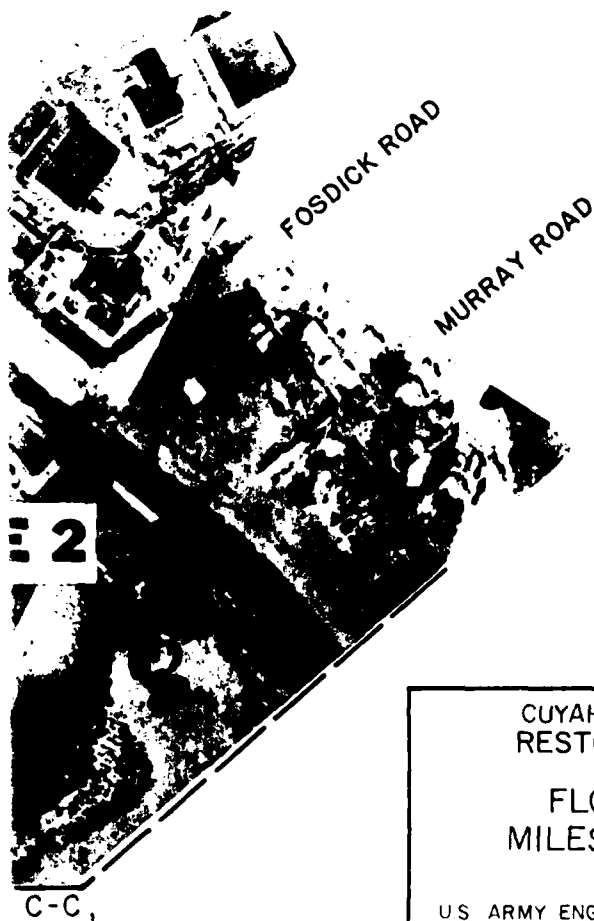


DISTANCE FROM MOUTH IN MILES



LIMIT OF FLOODING FOR THE SEPTEMBER 14, 1979
FLOOD (APPROXIMATELY 40 YEAR EVENT)

ALLEY VIEW



CUYAHOGA RIVER, OHIO
RESTORATION STUDY

FLOOD AREAS
MILES 11.7 TO 12.9

U.S. ARMY ENGINEER DISTRICT
DECEMBER 1985

BUFFALO

PLATE 3



JOIN WITH C-C,

This is an aerial photograph of a river area. A dashed line runs diagonally from the top left towards the bottom right. A solid line runs parallel to it, slightly below. A circular symbol with the number '13' is located near the top left. A north arrow is in the upper left corner. The text 'CUYAHOGA RIVER' is written across the middle. 'SITE 3' is labeled in a box in the lower middle. 'INDEPENDENCE' is labeled in a box at the bottom. A 'FLOW' arrow points towards the bottom right. A dashed line outlines a specific area on the right side of the river.

13

CUYAHOGA RIVER

SITE 3

INDEPENDENCE

FLOW



SCALE OF FE

400'

0

ROCKSIDE ROAD

CANAL ROAD

OHIO CANA

14

JOIN WITH D-D,

2

SCALE OF FEET

0 400' 800'

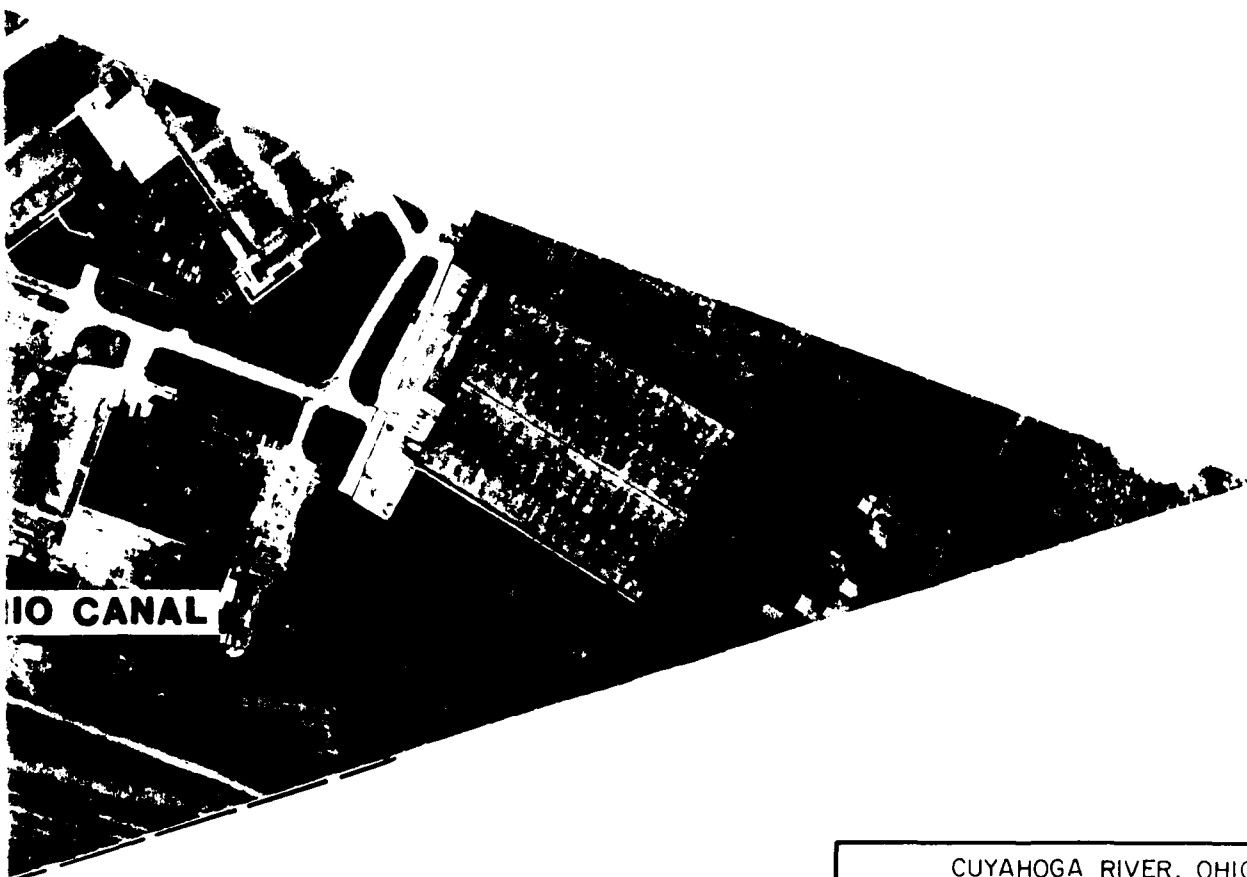
LEGEND:



DISTANCE FROM MOUTH IN MILES



LIMIT OF FLOODING FOR THE SEPTEMBER 14, 1979
FLOOD (APPROXIMATELY 40 YEAR EVENT)



CUYAHOGA RIVER, OHIO
RESTORATION STUDY

FLOOD AREAS
MILES 12.9 TO 14.2

U.S. ARMY ENGINEER DISTRICT
DECEMBER 1985

BUFFALO

PLATE 3



SITE 4

1D

STONE ROAD

FRANCIS DRIVE

CHARLES DRIVE

GLEESON ROAD

6

SCALE OF FEET



800

8



JOIN WITH E-E,

LEGEND:



DISTANCE FROM MOUTH IN MILES



LIMIT OF FLOODING FOR THE SEPTEMBER 14, 1979
FLOOD (APPROXIMATELY 40 YEAR EVENT)

CUYAHOGA RIVER, OHIO
RESTORATION STUDY

FLOOD AREAS
MILES 14.2 TO 16.4

U.S. ARMY ENGINEER DISTRICT
DECEMBER 1985

BUFFALO

PLATE 5

JOIN WITH E-E

HILLSIDE ROAD

OTIC CANAL

CANAL ROAD

CUYAHOGA RIVER

17



NAL

ROAD

17

PLEASANT VALLEY ROAD

TINKERS CR

SCALE OF

400'

0

SCALE OF FEET

0 400' 800'

LEGEND:



DISTANCE FROM MOUTH IN MILES



LIMIT OF FLOODING FOR THE SEPTEMBER 14, 1979
FLOOD (APPROXIMATELY 40 YEAR EVENT)

TINKERS CREEK

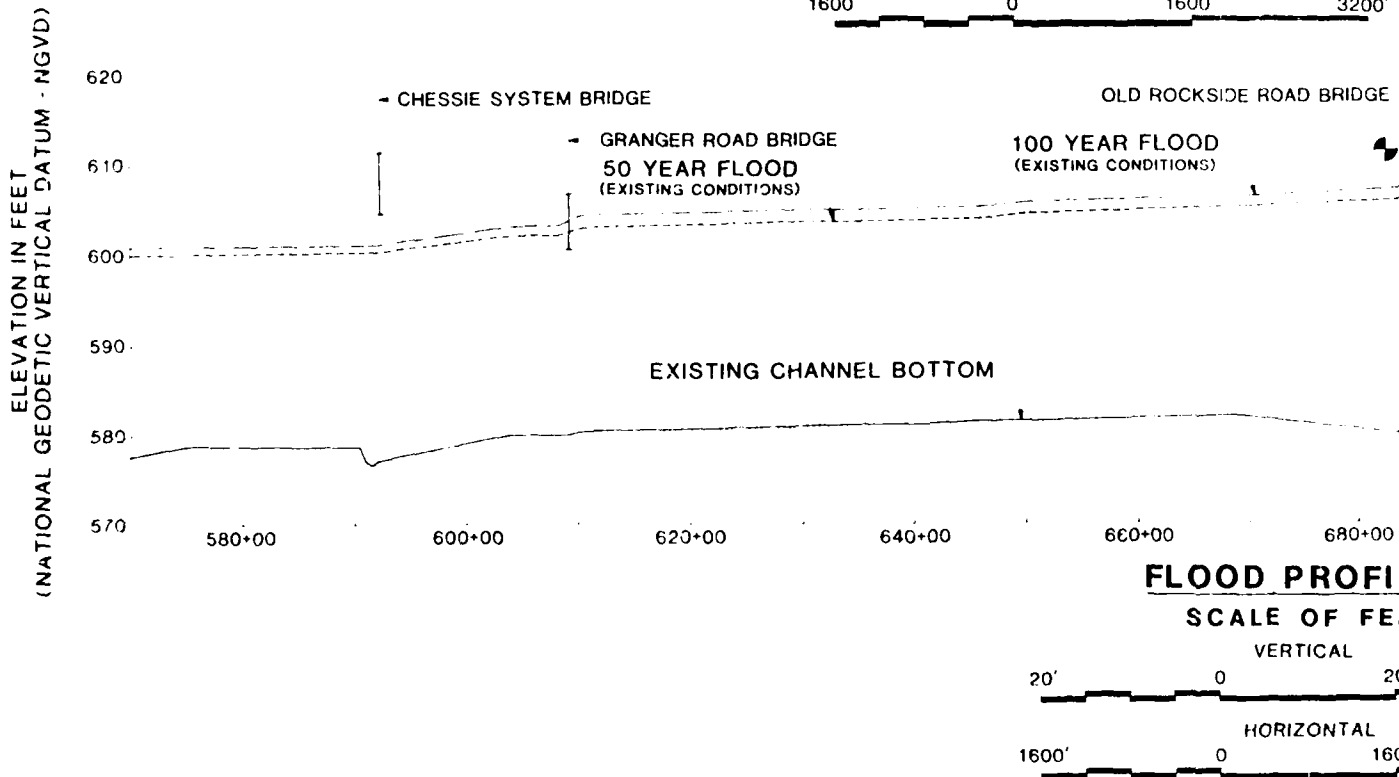
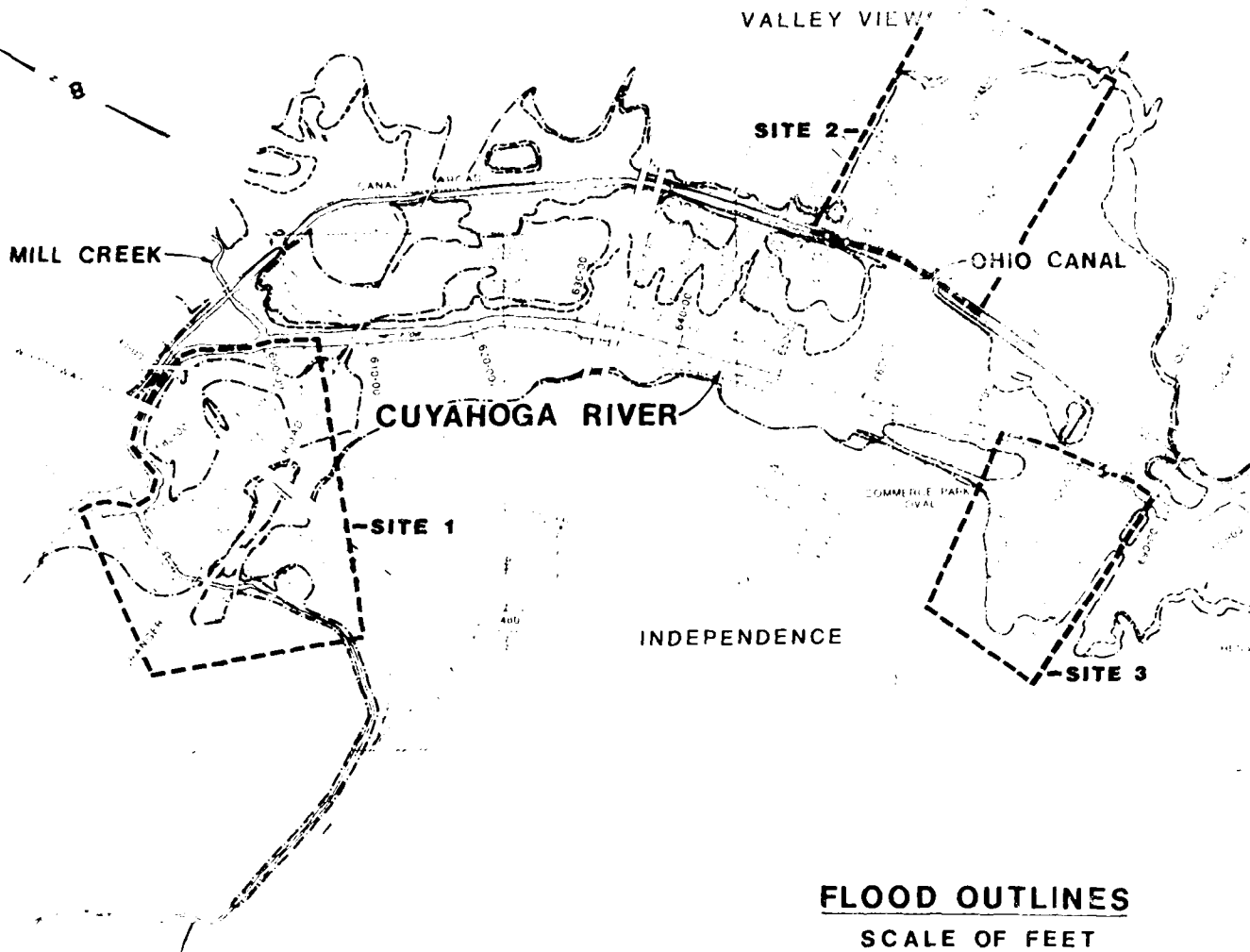


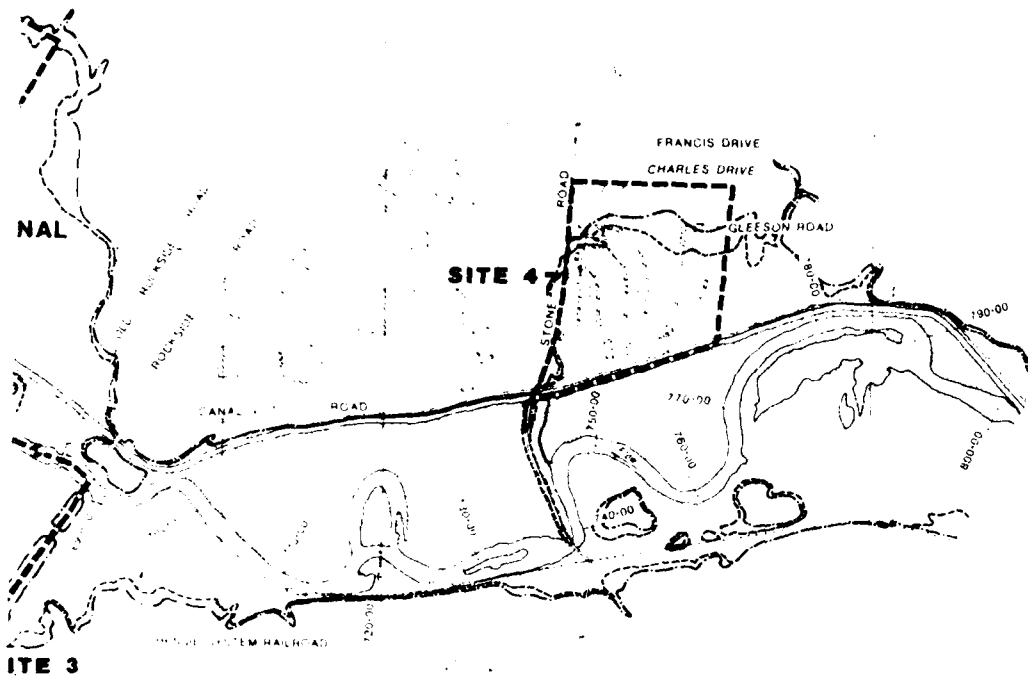
CUYAHOGA RIVER, OHIO
RESTORATION STUDY

FLOOD AREAS
MILES 16.4 TO 17.9

U.S. ARMY ENGINEER DISTRICT
DECEMBER 1985

BUFFALO





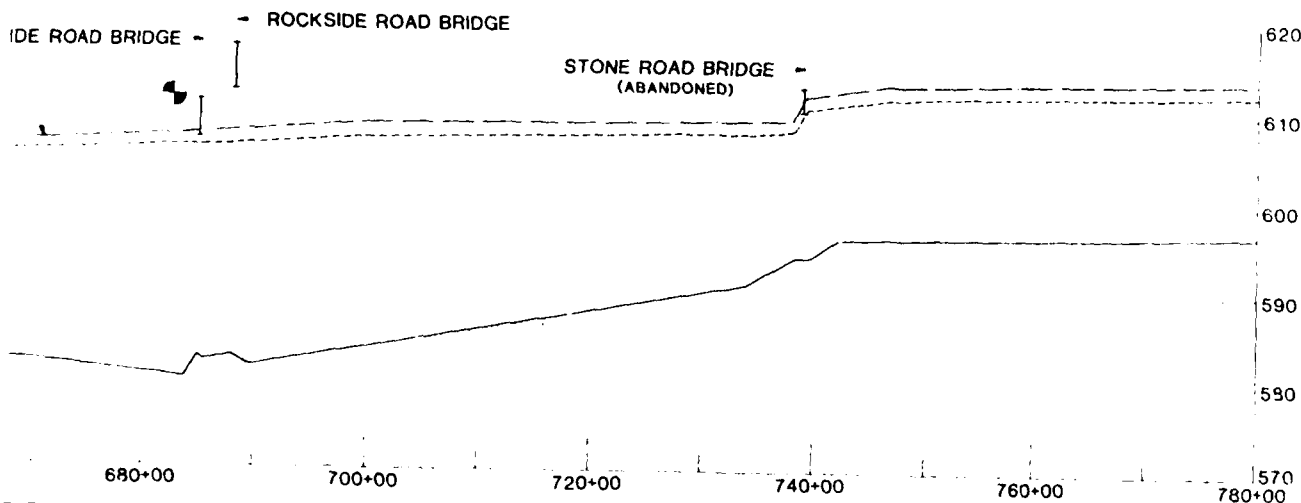
NOTES:

- 100-YEAR FLOOD
- 50-YEAR FLOOD
- 680+00 STATIONING
- I TOP OF BRIDGE
- LOW STEEL

ES

T

3200'



OD PROFILES

SCALE OF FEET

VERTICAL

20' 40'

HORIZONTAL

1600' 3200'

FLOOD

NOTES:

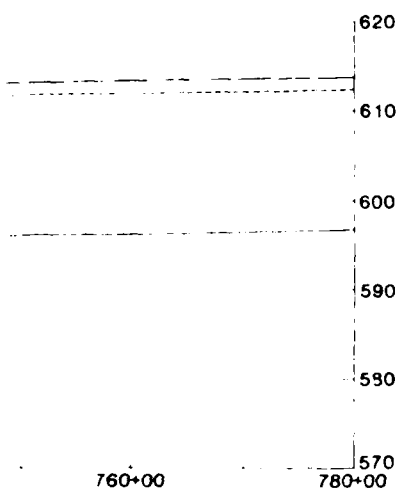
--- 100-YEAR FLOOD OUTLINE (EXISTING CONDITIONS)

--- 50-YEAR FLOOD OUTLINE (EXISTING CONDITIONS)

680+00 STATIONING IN HUNDREDS OF FEET

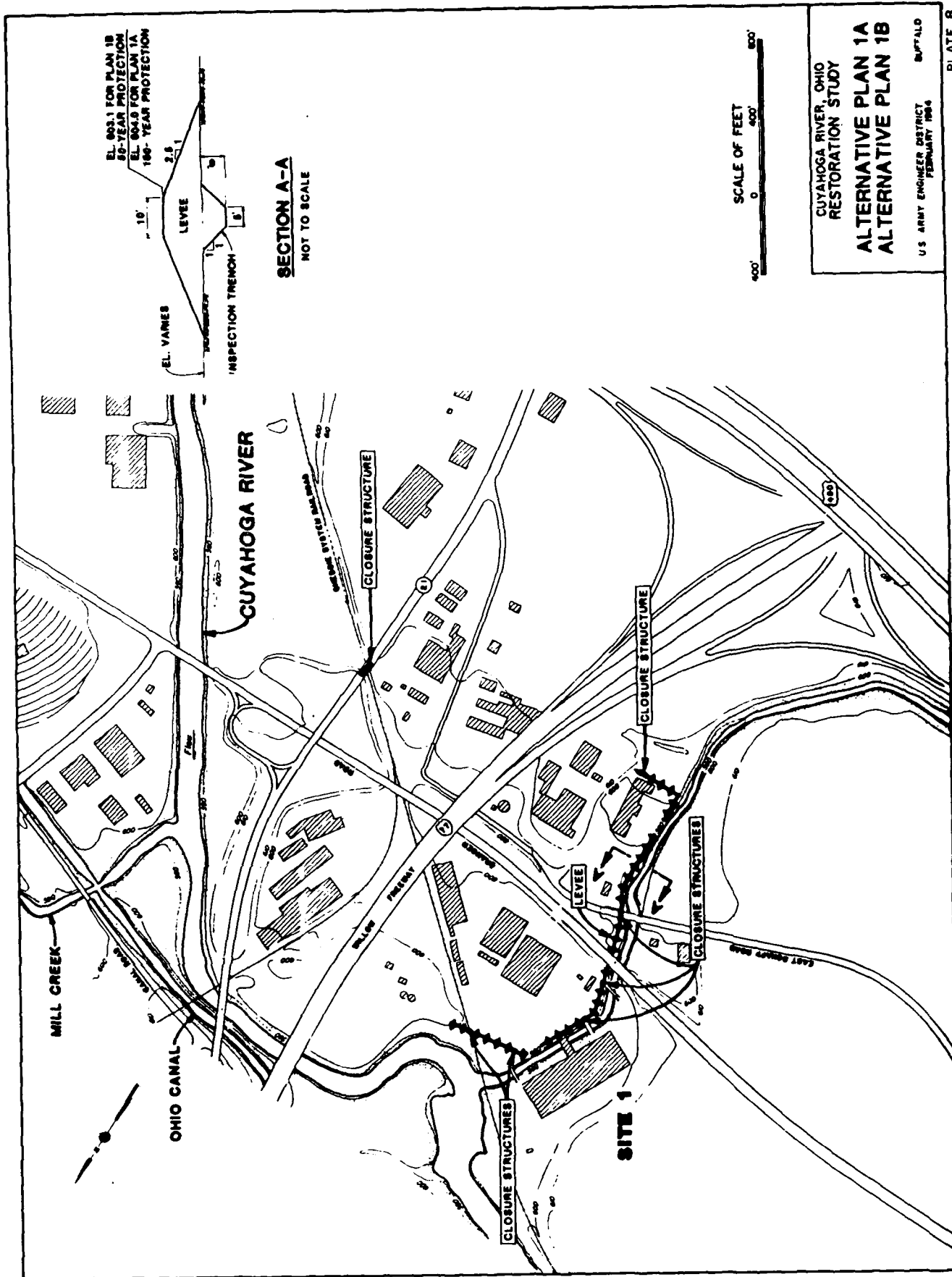
I TOP OF BRIDGE DECK

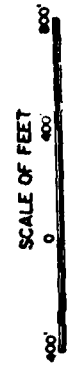
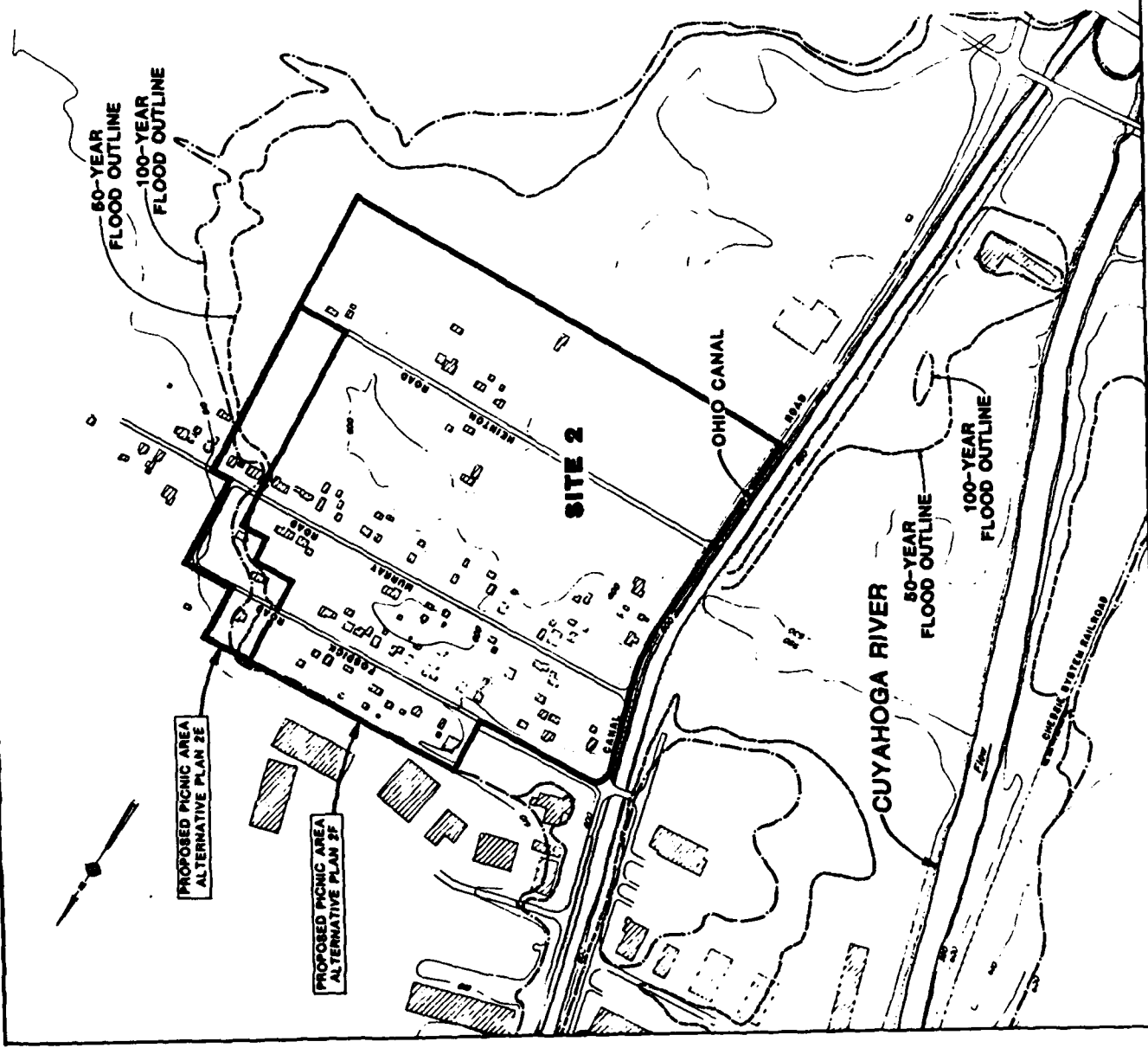
LOW STEEL



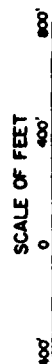
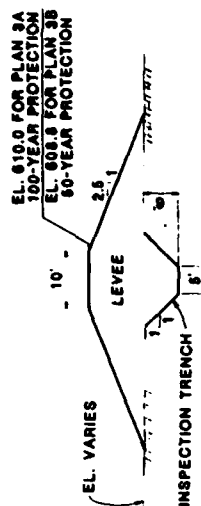
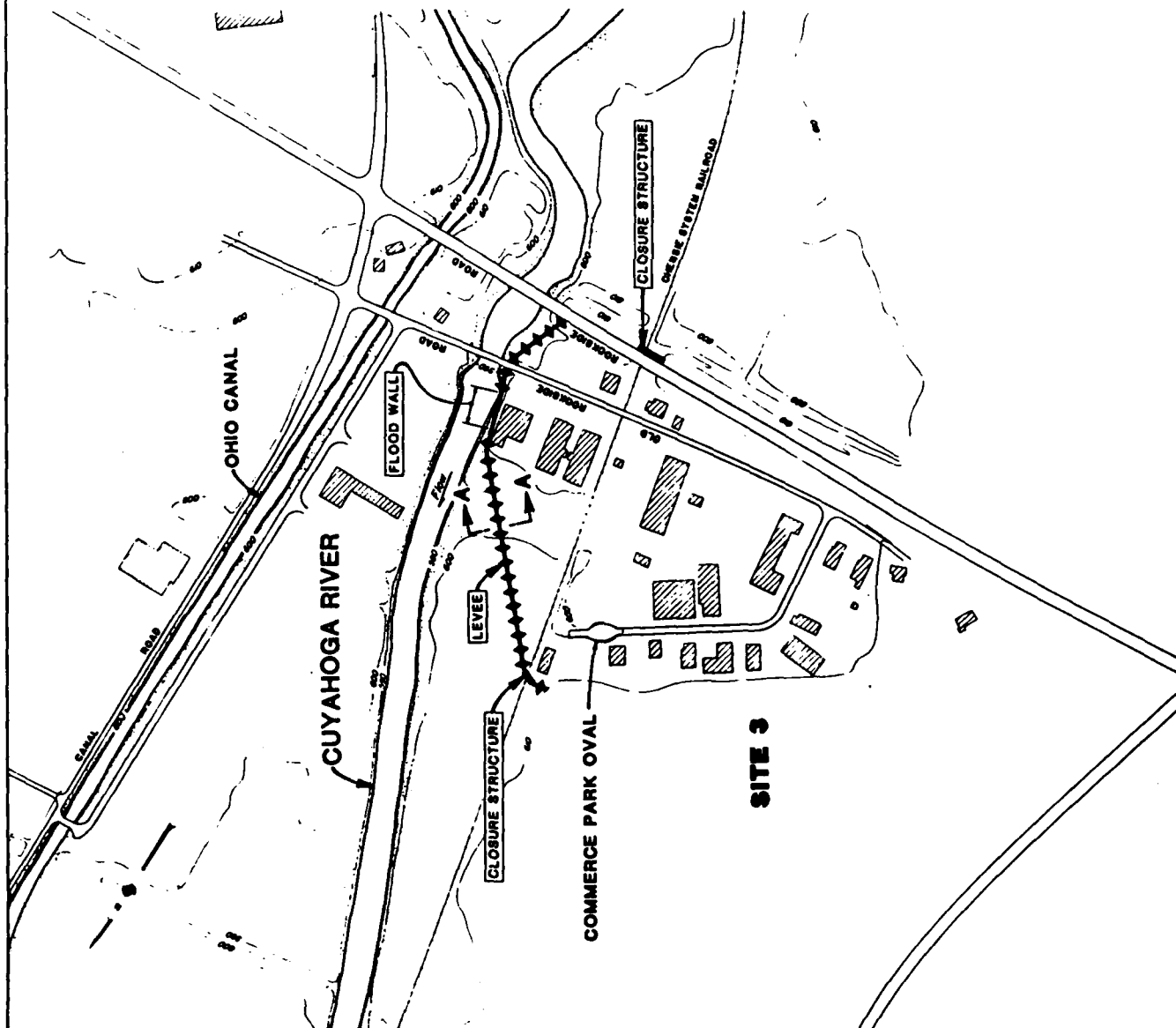
CUYAHOGA RIVER, OHIO
RESTORATION STUDY
50-YEAR AND 100-YEAR
FLOOD OUTLINES AND PROFILES
(EXISTING CONDITIONS)

U.S. ARMY ENGINEER DISTRICT BUFFALO
DECEMBER 1985





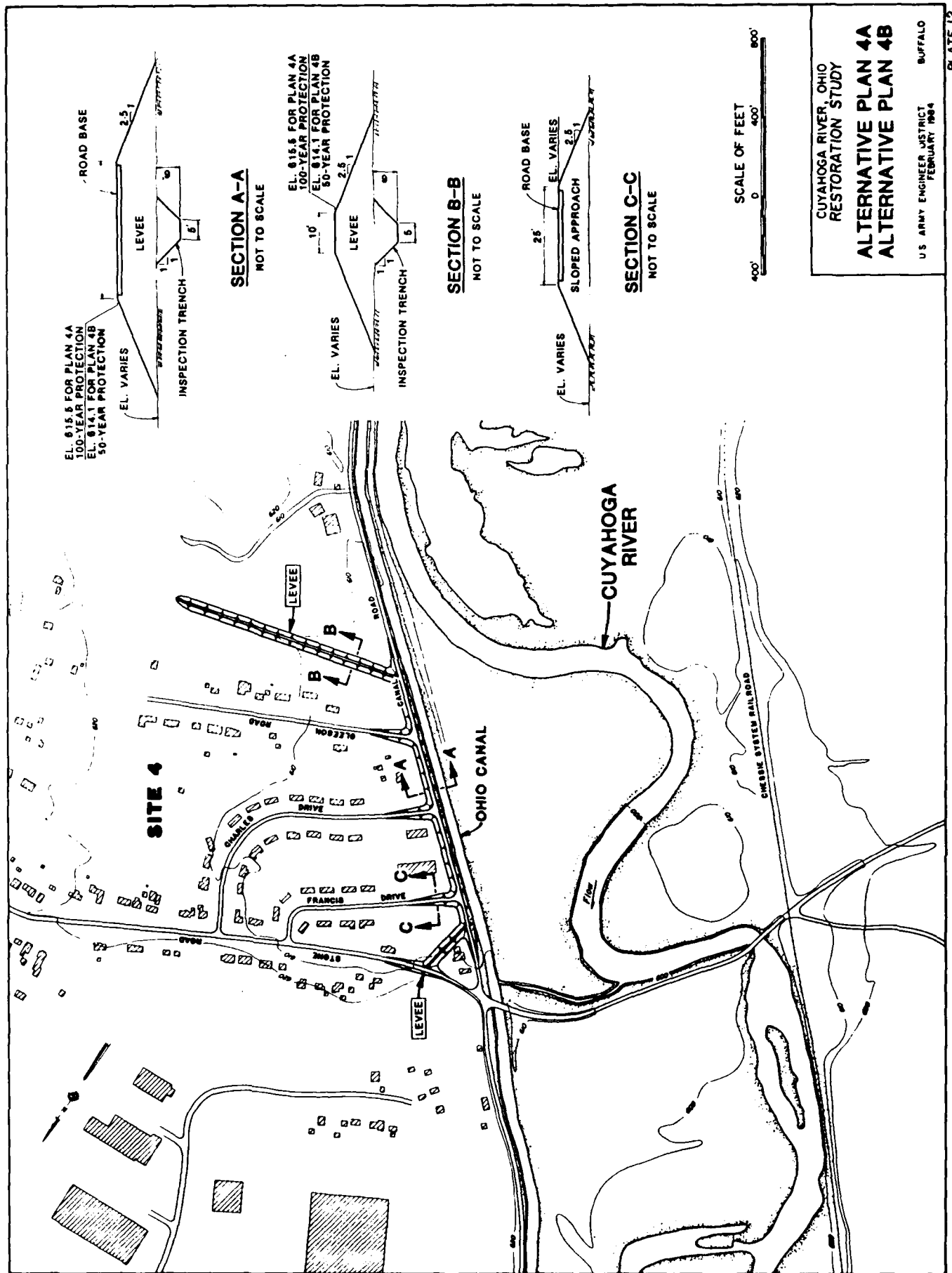
CUYAHOGA RIVER, OHIO
RESTORATION STUDY
ALTERNATIVE PLAN 2E
ALTERNATIVE PLAN 2F
U.S. ARMY ENGINEER DISTRICT BUFFALO
FEBRUARY 1994



CUYAHOGA RIVER, OHIO
RESTORATION STUDY

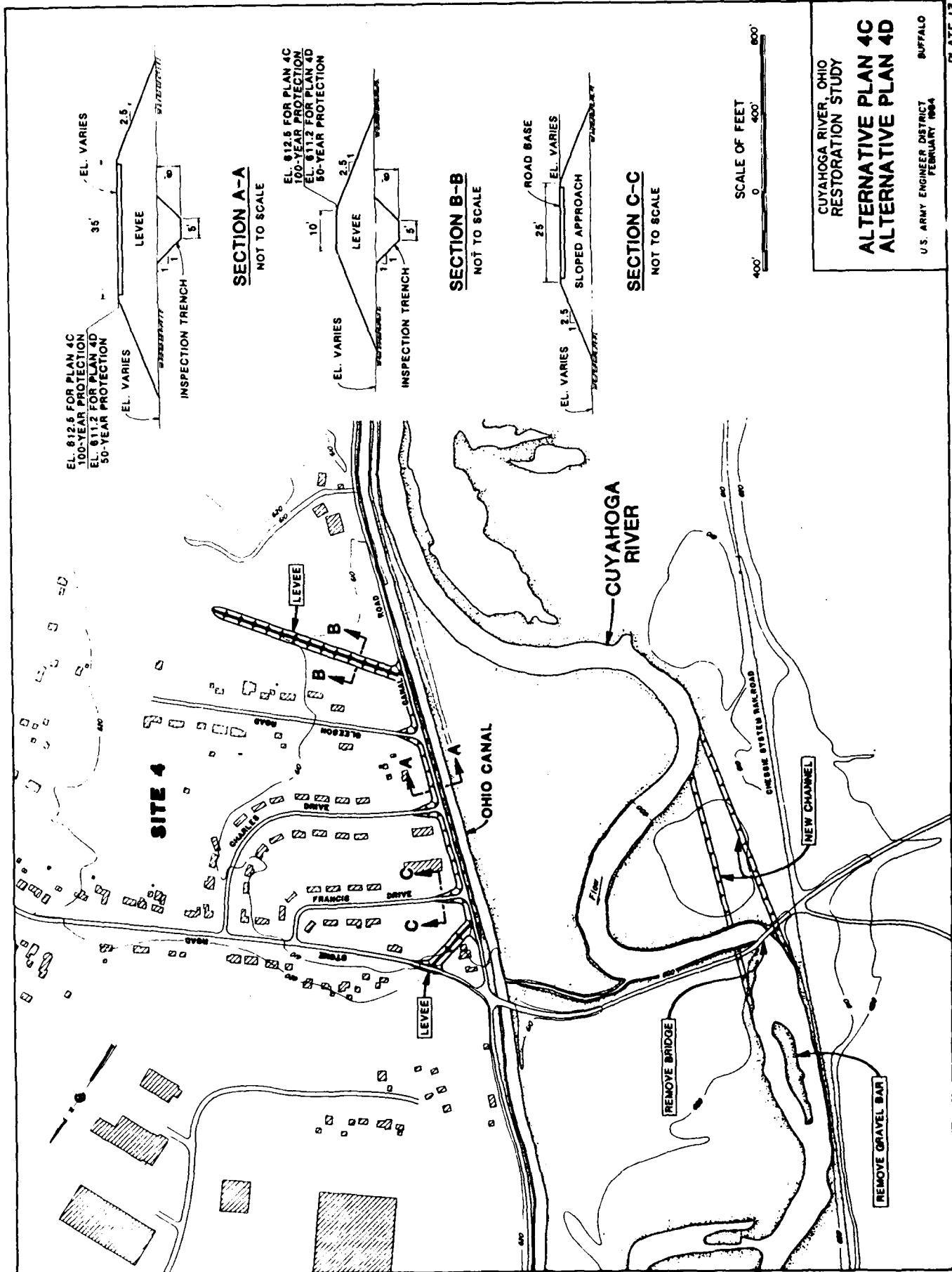
ALTERNATIVE PLAN 3A
ALTERNATIVE PLAN 3B

U.S. ARMY ENGINEER DISTRICT
BUFFALO
FEBRUARY 1964

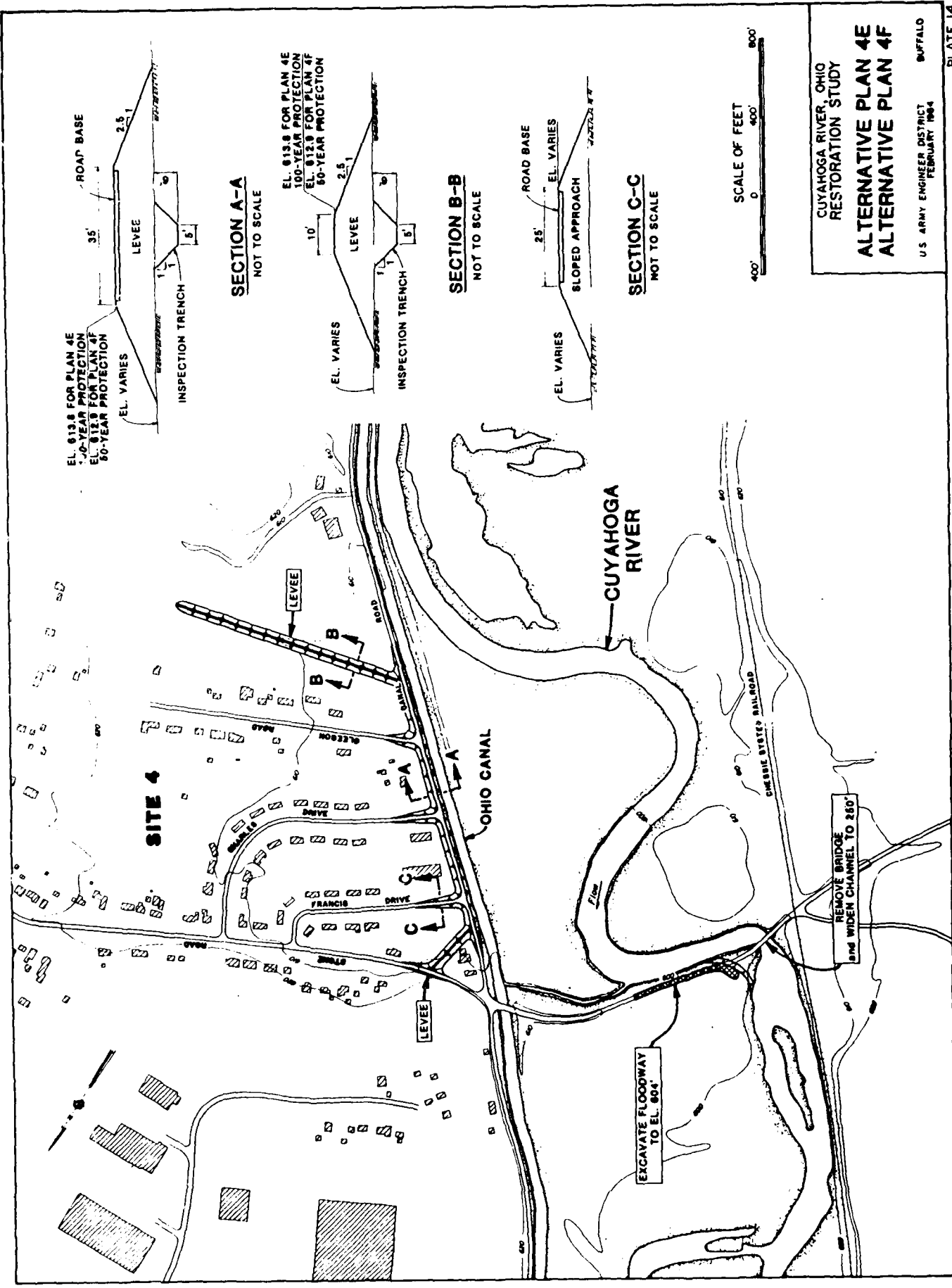


CUYAHOGA RIVER, OHIO
RESTORATION STUDY
ALTERNATIVE PLAN 4A
ALTERNATIVE PLAN 4B

U.S. ARMY ENGINEER DISTRICT
BUFFALO
FEBRUARY 1994

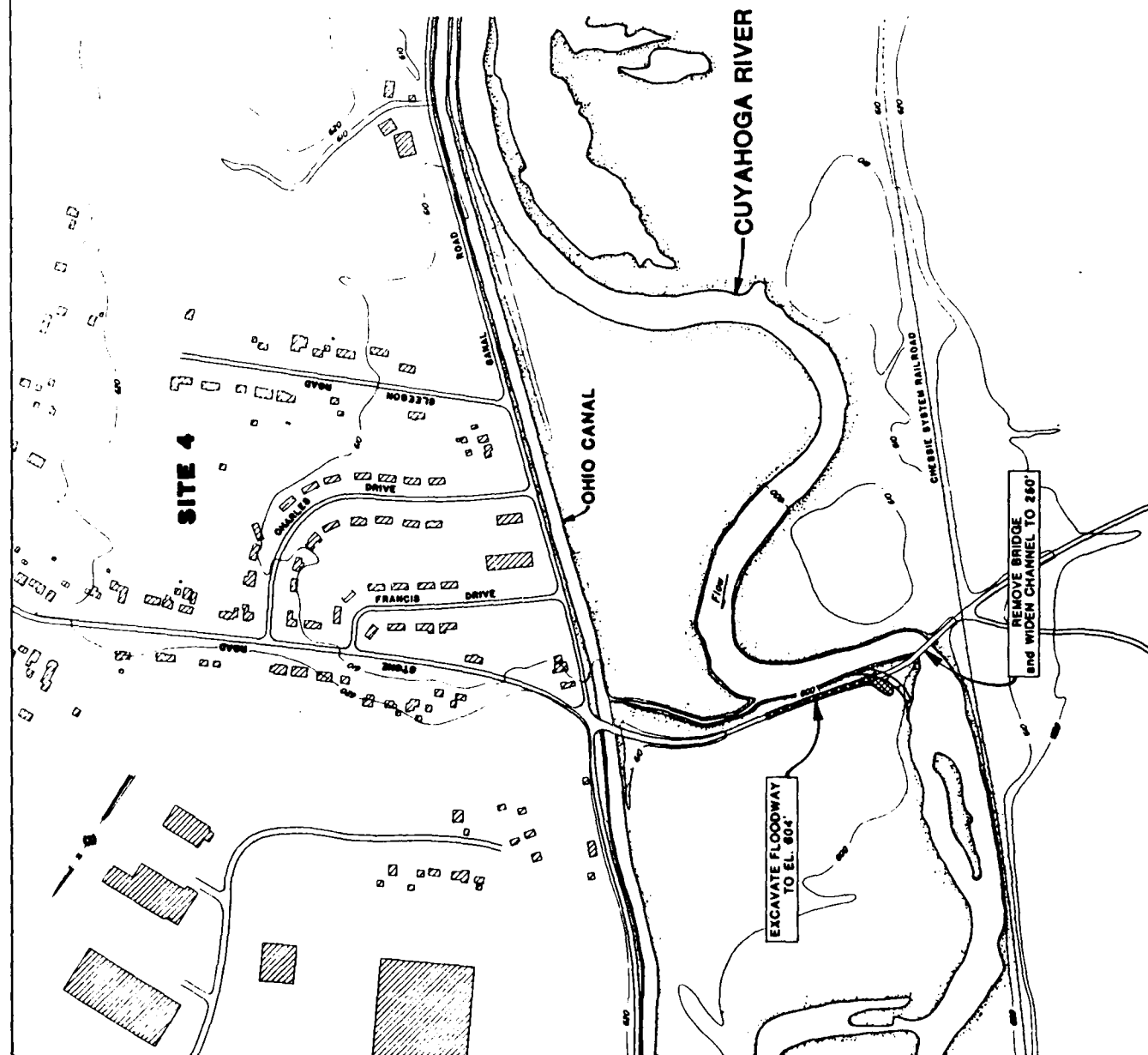


CUYAHOGA RIVER, OHIO
RESTORATION STUDY
ALTERNATIVE PLAN 4C
ALTERNATIVE PLAN 4D
U.S. ARMY ENGINEER DISTRICT BUFFALO
FEBRUARY 1984



CUYAHOGA RIVER, OHIO
RESTORATION STUDY
ALTERNATIVE PLAN 4E
ALTERNATIVE PLAN 4F

U.S. ARMY ENGINEER DISTRICT
BUFFALO
FEBRUARY 1964



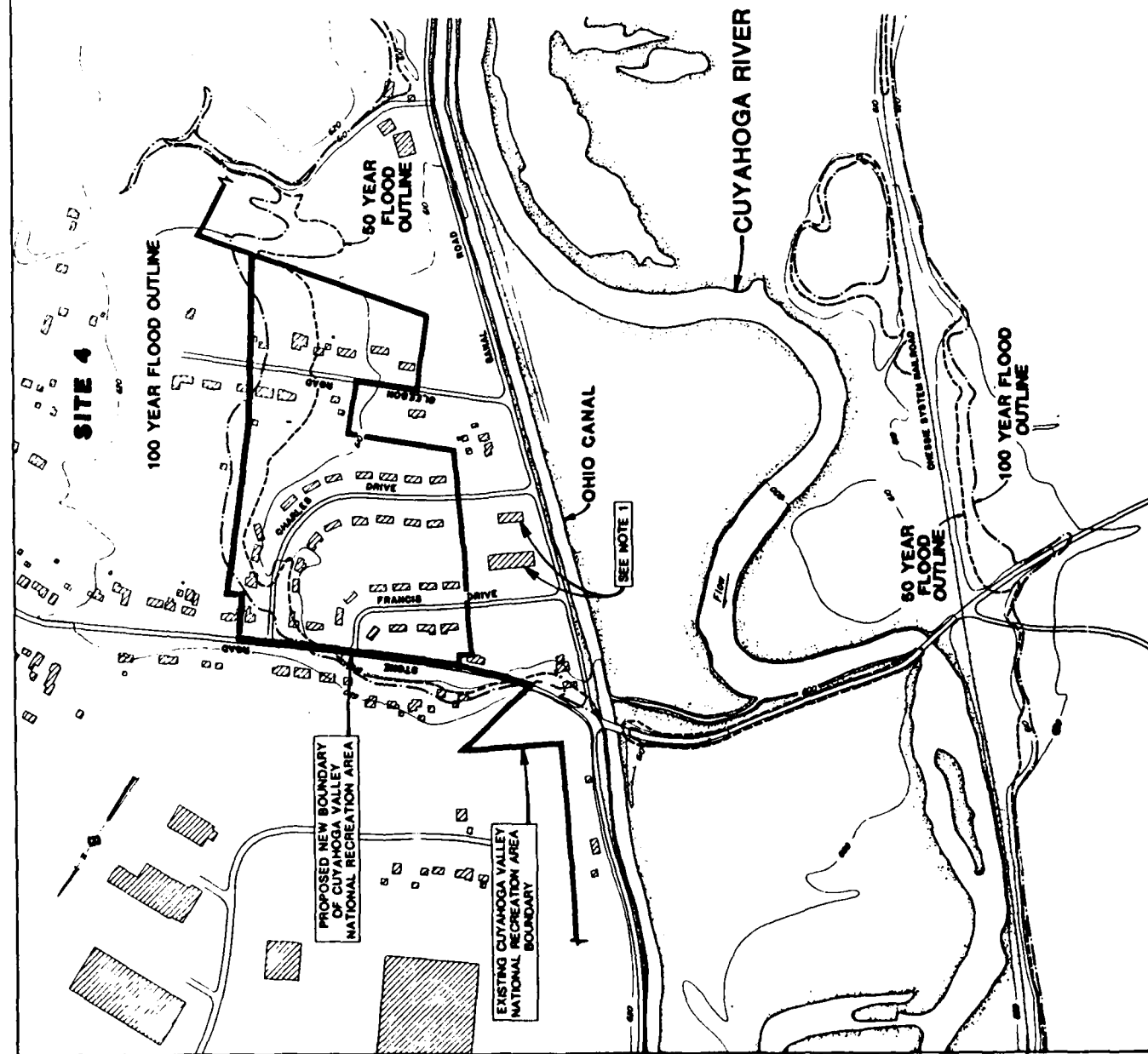
SCALE OF FEET
0 400' 800'

CUYAHOGA RIVER, OHIO
RESTORATION STUDY

ALTERNATIVE PLAN 4G

U.S. ARMY ENGINEER DISTRICT
BUFFALO
FEBRUARY 1964

PLATE 15



NOTES:
1. COMMERCIAL SITE TO BE FLOODPROOFED.

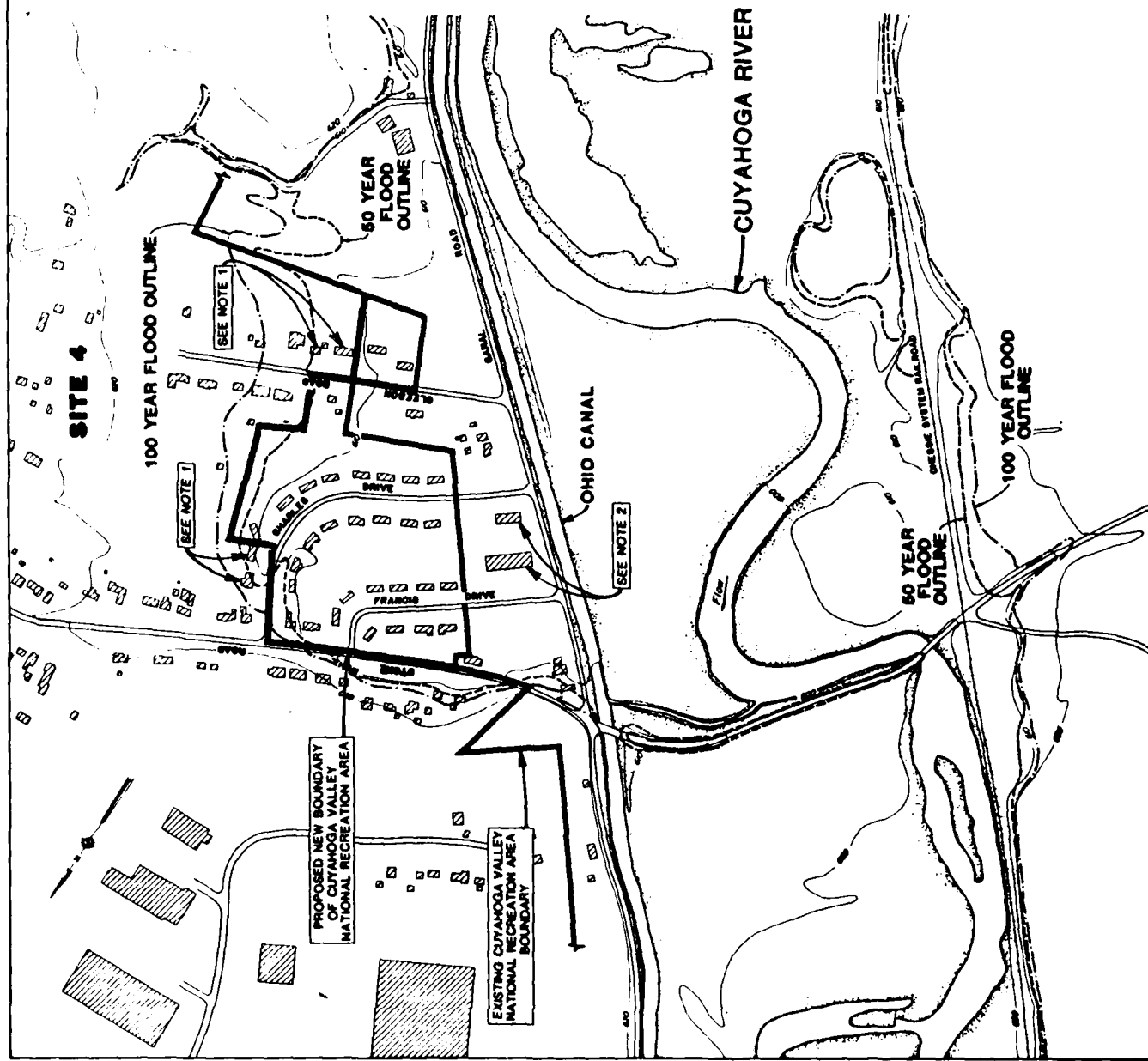
SCALE OF FEET
0 400' 800'

CUYAHOGA RIVER, OHIO
RESTORATION STUDY

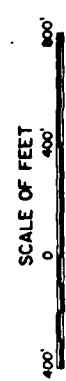
ALTERNATIVE PLAN 4J

U.S. ARMY ENGINEER DISTRICT
BUFFALO
FEBRUARY 1984

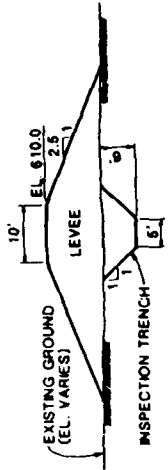
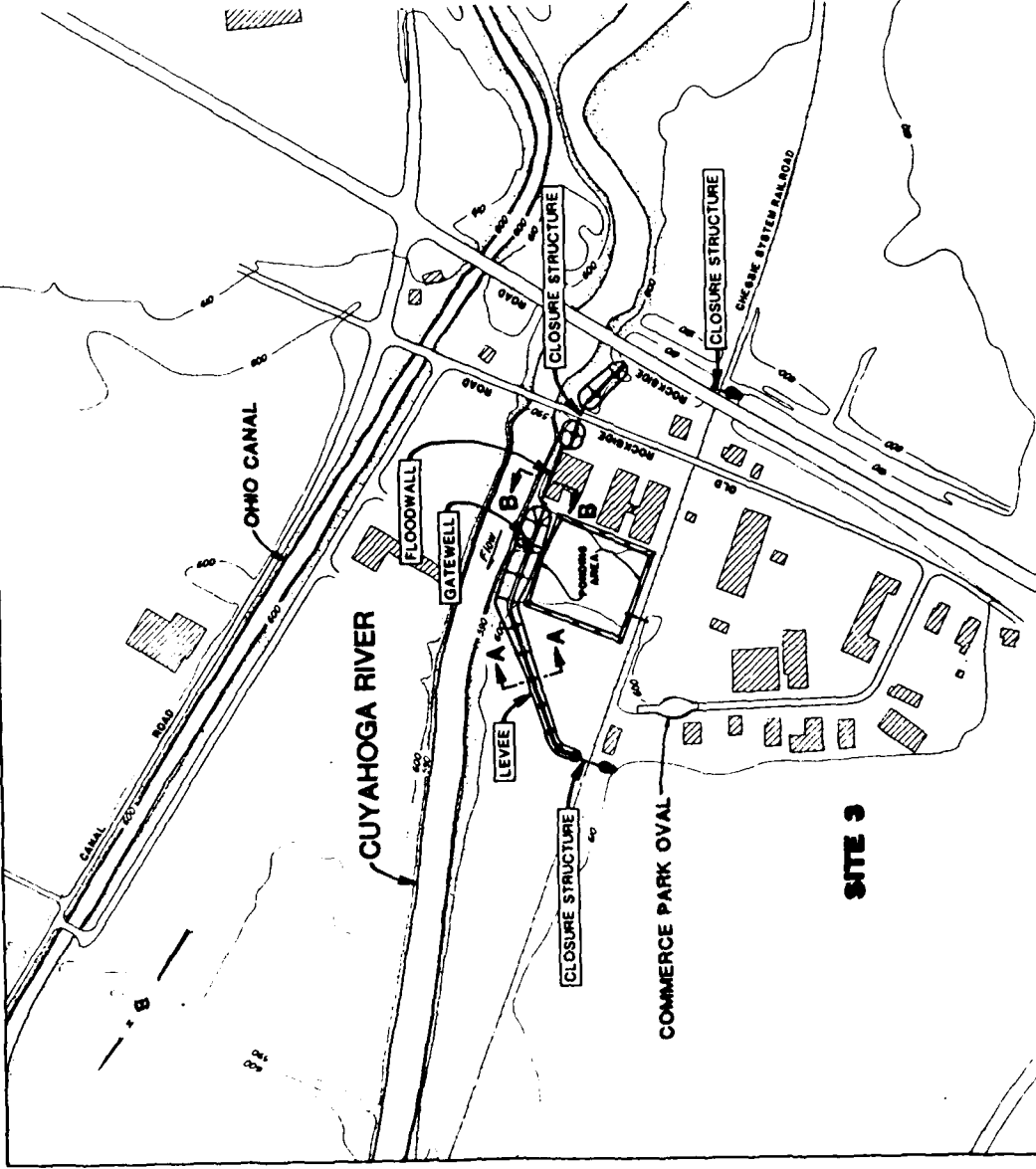
PLATE 16



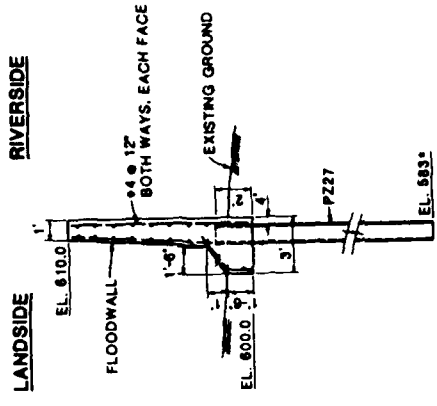
- NOTES:**
1. ALTHOUGH THESE RESIDENCES ARE WITHIN THE 50-YEAR FLOOD OUTLINE, THEY DO NOT SUSTAIN ANY SIGNIFICANT FLOOD DAMAGE AND THEREFORE HAVE BEEN EXCLUDED FROM THE RELOCATION PLAN.
 2. COMMERCIAL SITE TO BE FLOODPROOFED.



CUYAHOGA RIVER, OHIO
RESTORATION STUDY
ALTERNATIVE PLAN 4K
U.S. ARMY ENGINEER DISTRICT
BUFFALO
FEBRUARY 1964



SECTION A-A
NOT TO SCALE

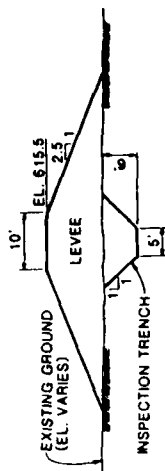
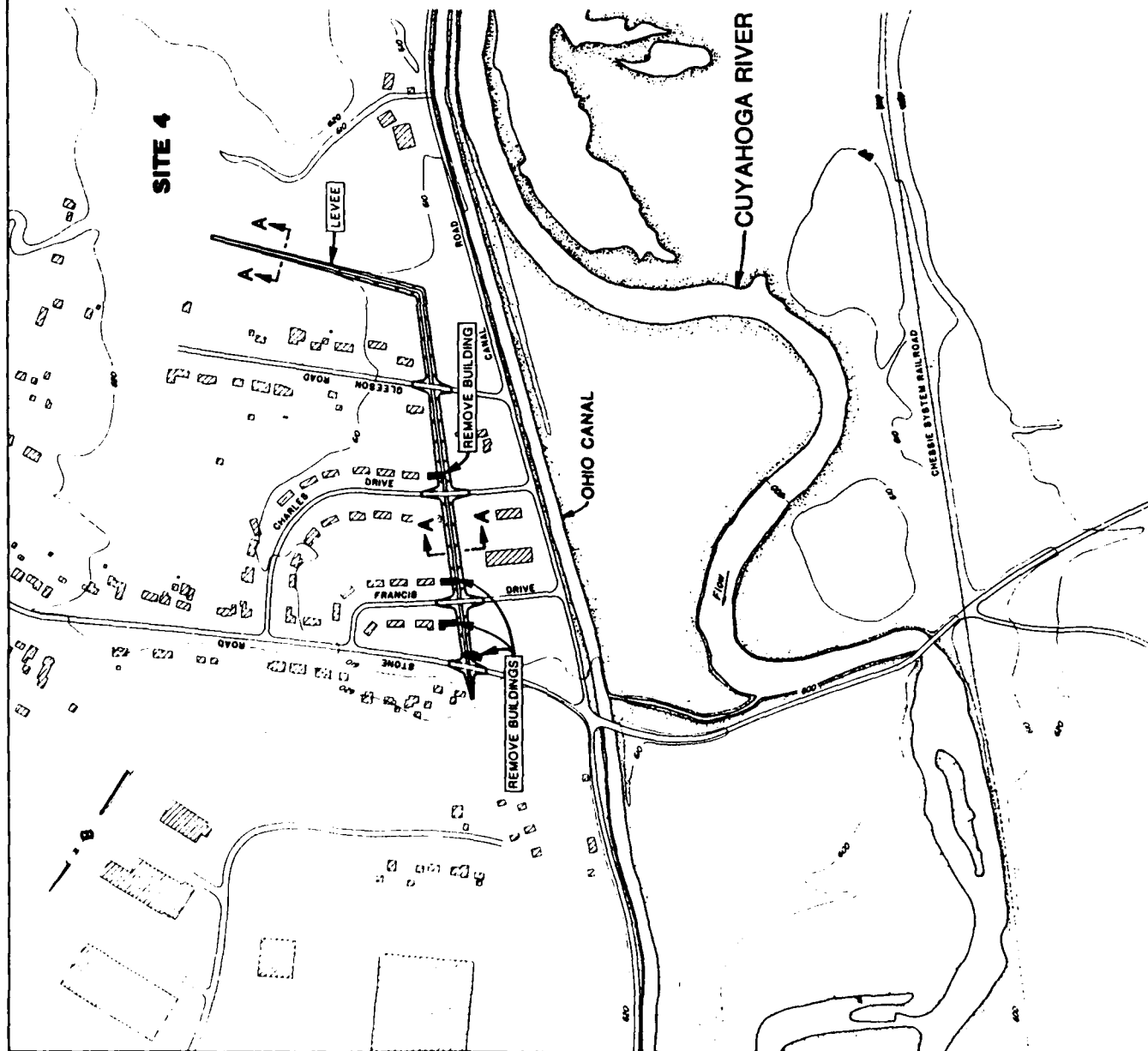


SECTION B-B
NOT TO SCALE

CUYAHOGA RIVER, OHIO
RESTORATION STUDY

PLAN 3A
(MODIFIED)

U.S. ARMY ENGINEER DISTRICT
BUFFALO
DECEMBER 1985

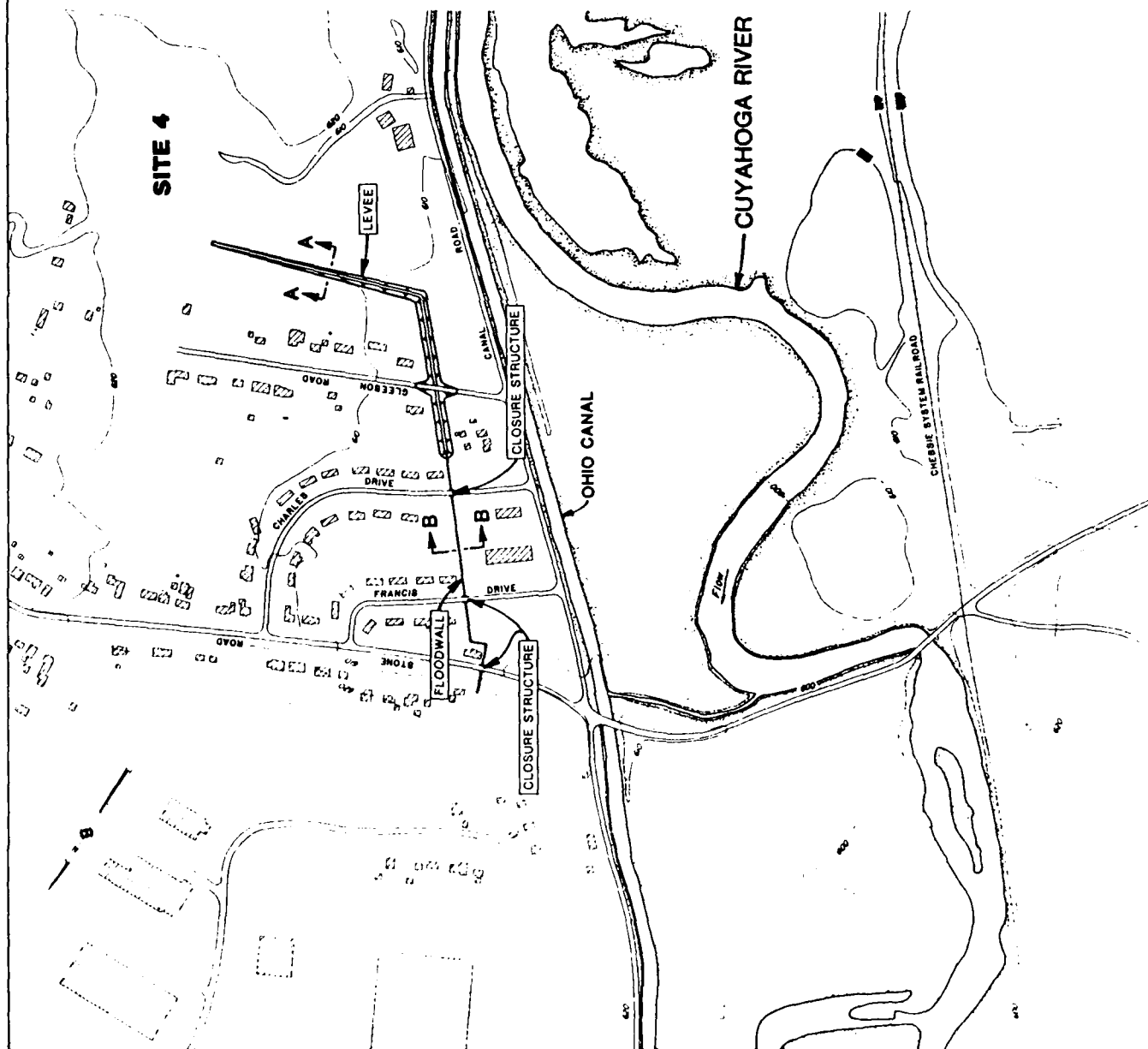


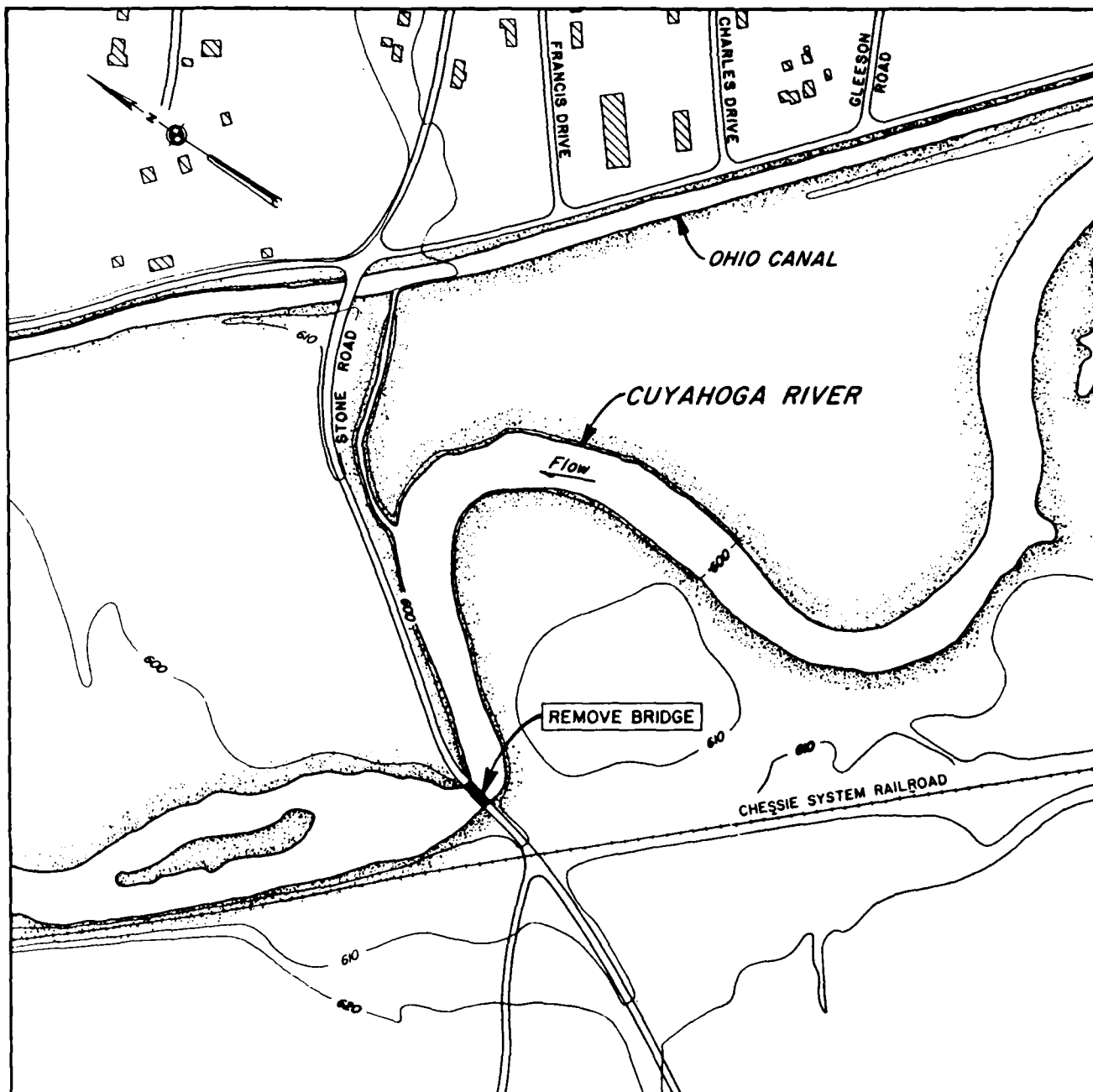
CUYAHOGA RIVER, OHIO
RESTORATION STUDY

PLAN 4A (I)

U.S. ARMY ENGINEER DISTRICT
BUFFALO
DECEMBER 1965

PLATE 19





SCALE OF FEET
200' 0 200' 400' 600'

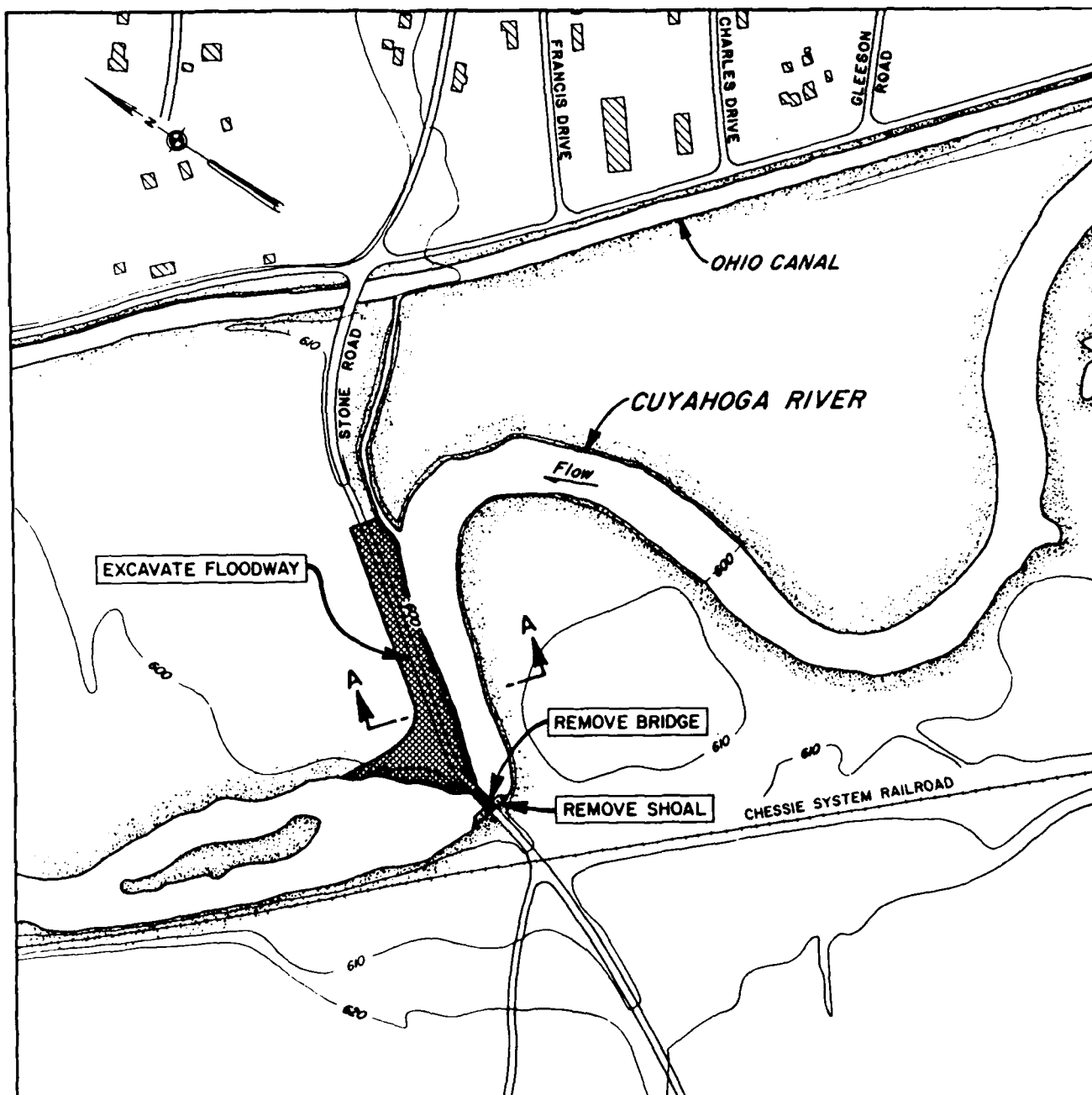
CUYAHOGA RIVER, OHIO
RESTORATION STUDY

PLAN 4G(I)

U.S. ARMY ENGINEER DISTRICT
DECEMBER 1985

BUFFALO

PLATE 21



SCALE OF FEET
200' 0 200' 400' 600'



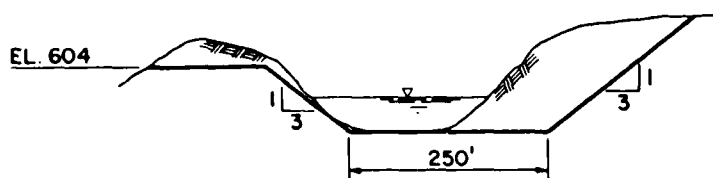
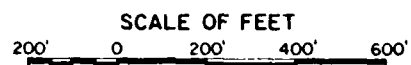
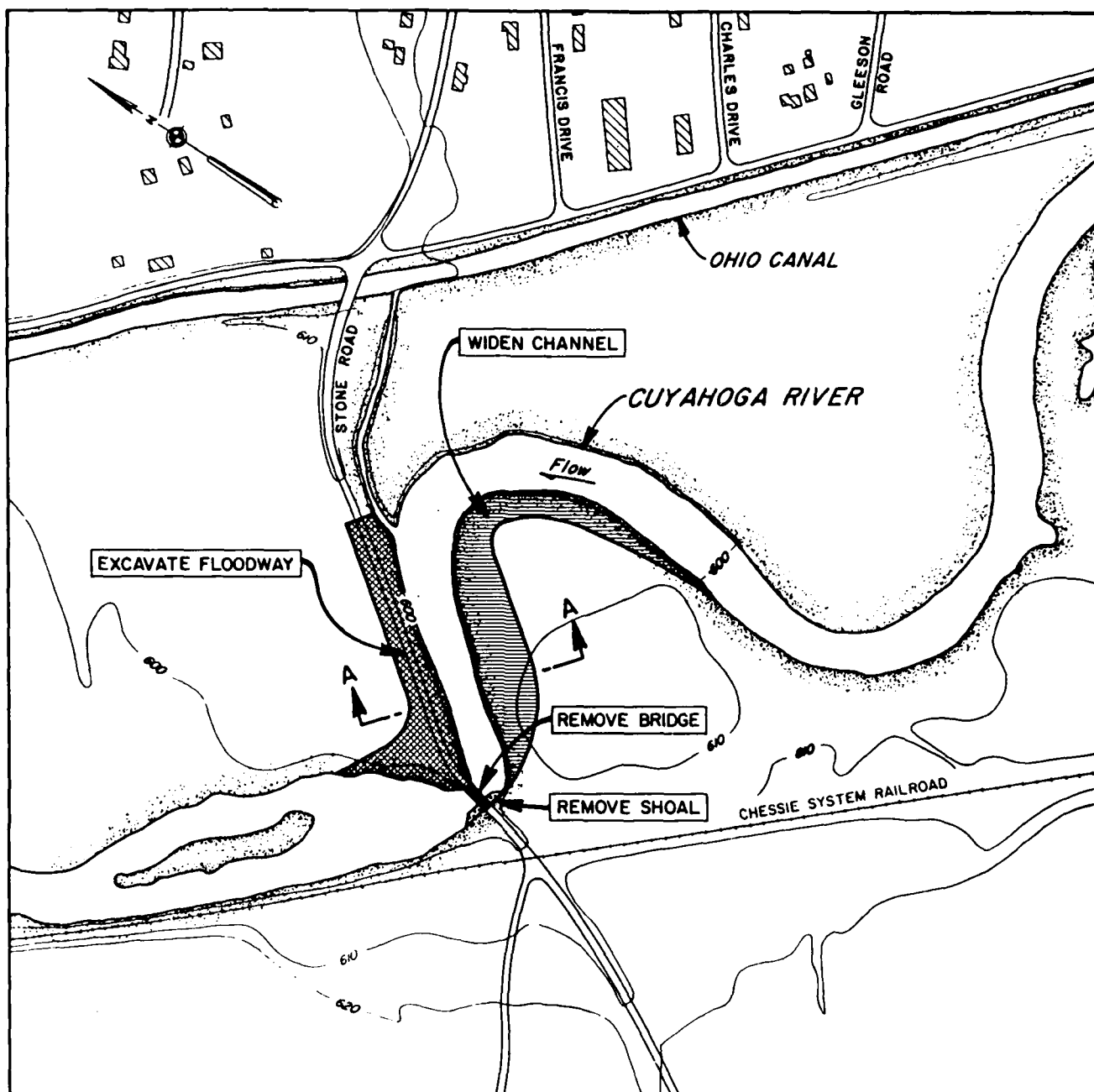
SECTION A-A
NOT TO SCALE

**CUYAHOGA RIVER, OHIO
RESTORATION STUDY**

PLAN 4G(II)

**U.S. ARMY ENGINEER DISTRICT
DECEMBER 1985**

BUFFALO



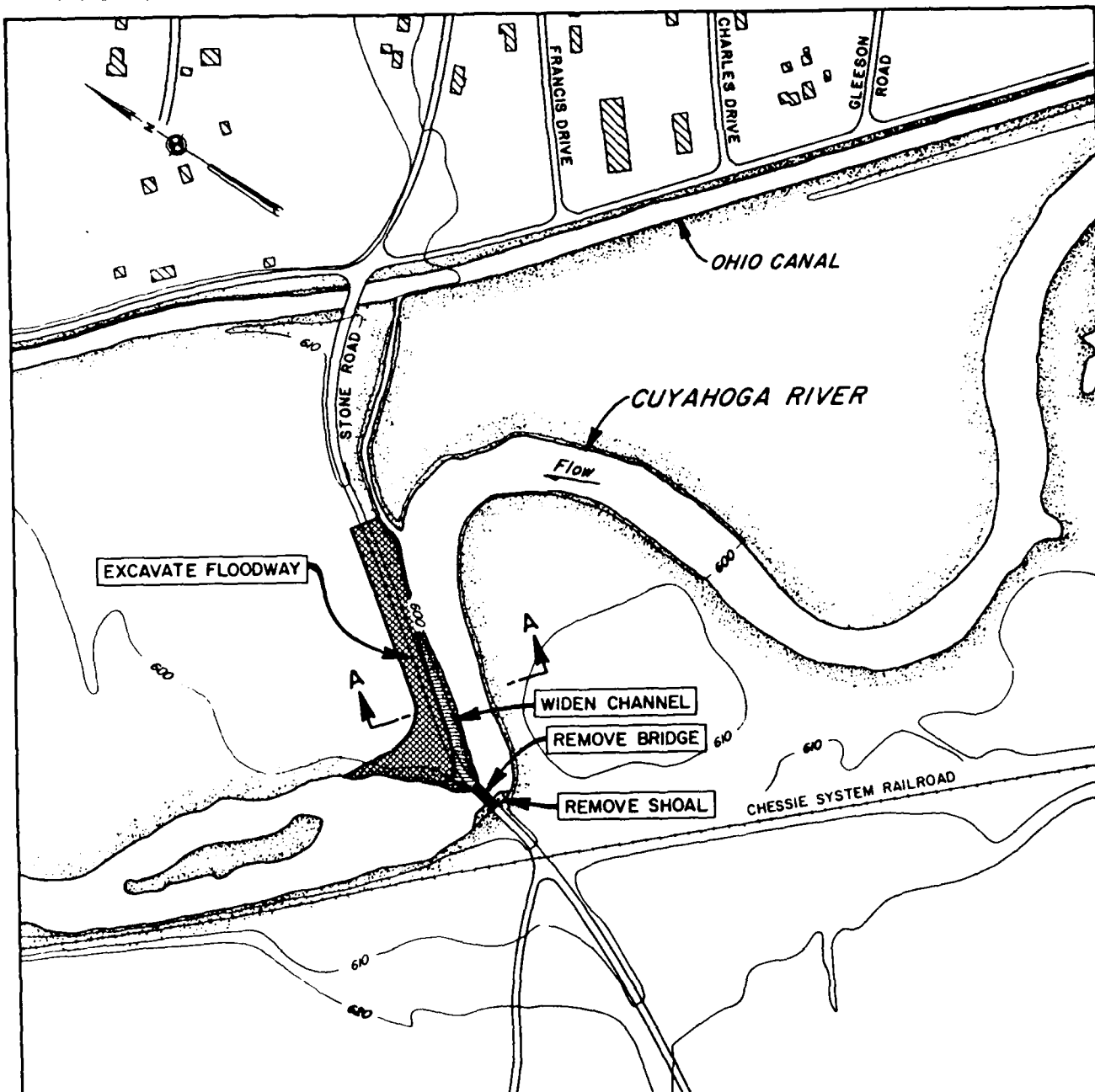
SECTION A-A
NOT TO SCALE

CUYAHOGA RIVER, OHIO
RESTORATION STUDY

PLAN 4G (III)

U.S. ARMY ENGINEER DISTRICT
DECEMBER 1985

BUFFALO



SCALE OF FEET
200' 0 200' 400' 600'

EL. 604 PLAN 4G(IV)
EL. 605 PLAN 4G(V)
EL. 606 PLAN 4G(VI)

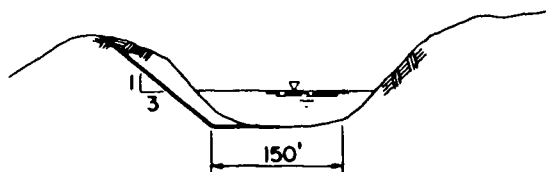
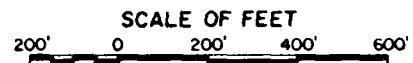
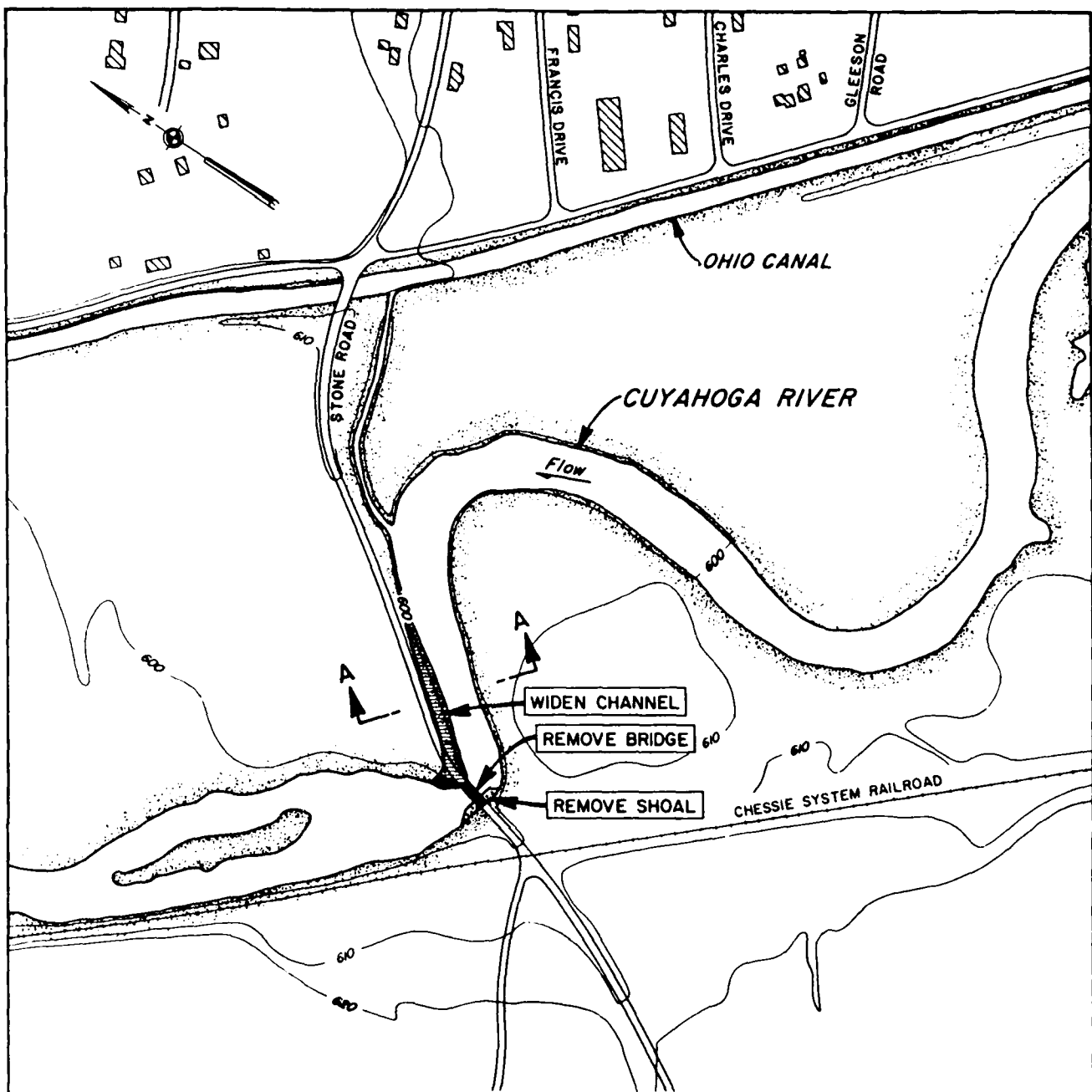
SECTION A-A
NOT TO SCALE

**CUYAHOGA RIVER, OHIO
RESTORATION STUDY**

**PLAN 4G(IV)
PLAN 4G(V)
PLAN 4G(VI)**

U.S. ARMY ENGINEER DISTRICT
DECEMBER 1985

BUFFALO



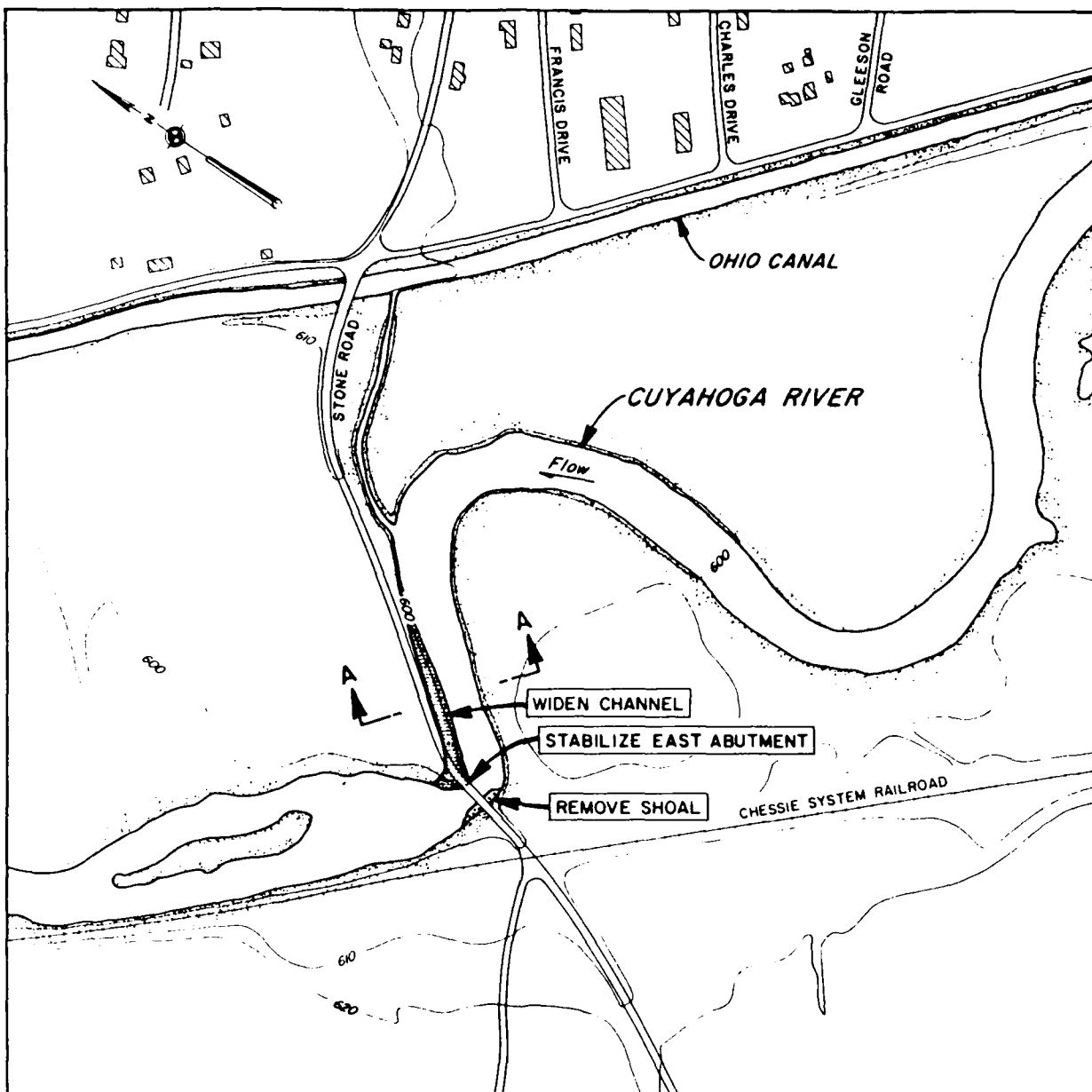
SECTION A-A
NOT TO SCALE

**CUYAHOGA RIVER, OHIO
RESTORATION STUDY**

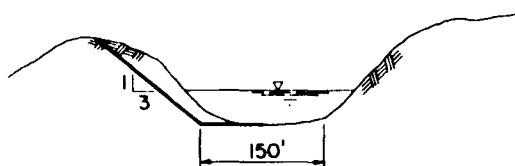
PLAN 4G(VII)

U.S. ARMY ENGINEER DISTRICT
DECEMBER 1985

BUFFALO



SCALE OF FEET
200' 0 200' 400' 600'



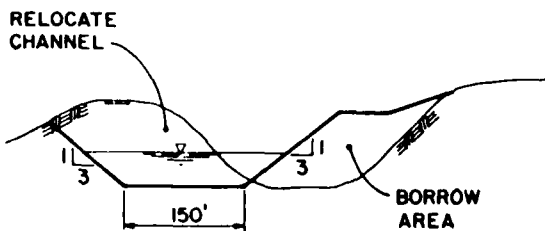
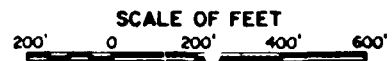
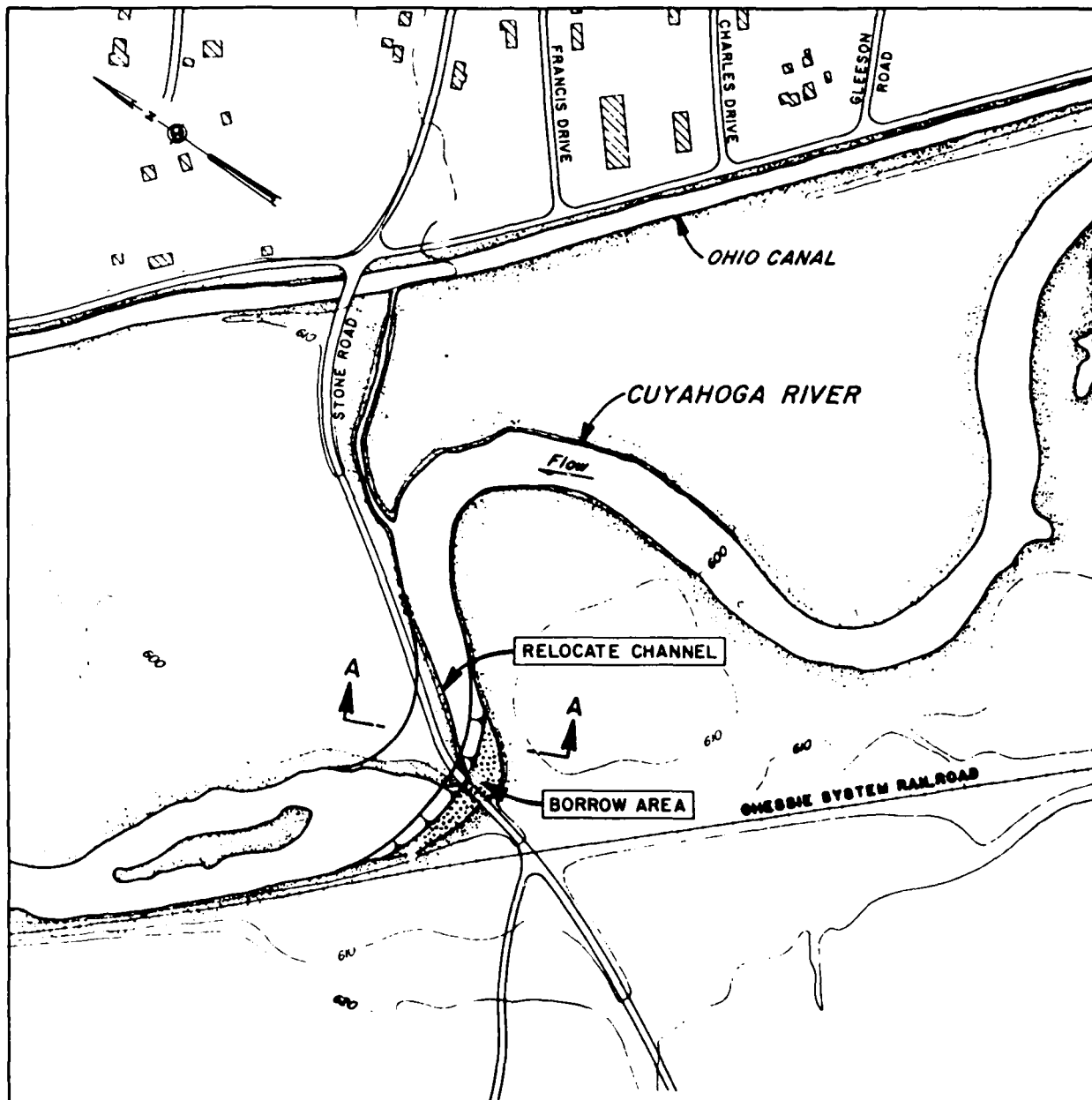
SECTION A-A
NOT TO SCALE

CUYAHOGA RIVER, OHIO
RESTORATION STUDY

PLAN 4G(VIII)

U.S. ARMY ENGINEER DISTRICT
DECEMBER 1985

BUFFALO



SECTION A-A
NOT TO SCALE

CUYAHOGA RIVER, OHIO
RESTORATION STUDY

PLAN 4G(IX)

U.S. ARMY ENGINEER DISTRICT
DECEMBER 1985

BUFFALO